US Army Corps
of Engineers
Omaha District

Annual Report - 1995

Tributary Reservoir Regulation Activities

(August 1994 - July 1995)

Prepared by:
Water Control Section
Hydrologic Engineering Branch
Engineering Division
Omaha, Nebraska

December 1995

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
DEC 1995		**00-00-1995 to 00-00-1995**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Tributary Reservoir Regulation Activities (August 1994 - July 1995)	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,Omaha District,1616 Capital Avenue Ste 9000,Omaha,NE,68102**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT	b ABSTRACT	c THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**200**	

This report is the Omaha District's portion of the Missouri River Division's 1994-1995 Annual Report on Reservoir Regulation Activities

ANNUAL REPORT - 1995
TRIBUTARY RESERVOIR REGULATION ACTIVITIES
(AUGUST 1994 - JULY 1995)
MISSOURI RIVER DIVISION
OMAHA DISTRICT

FIGURES PAGE

PLATES

1. Basin Map - Federal Tributary Projects
2. Summary of Engineering Data - Tributary Reservoirs - Colorado, North Dakota, Montana
3. Summary of Engineering Data - Salt Creek Basin, Nebraska
4. Summary of Engineering Data - Papillion Creek Basin, Nebraska; South Dakota
5. Summary of Engineering Data - Bureau Reclamation Dams
6. Summary of Engineering Data - Missouri River Mainstem Reservoirs
7. Long Term Palmer Drought Severity Maps 1992 and 1993
8. Long Term Palmer Drought Severity Maps 1994 and 1995

APPENDIX 1 - PROJECT OPERATION SUMMARIES

ANNUAL REPORT
TRIBUTARY RESERVOIR REGULATION ACTIVITIES
(AUGUST 1994 - JULY 1995)
MISSOURI RIVER DIVISION
OMAHA DISTRICT

I. PURPOSE AND SCOPE. This annual report summarizes significant tributary reservoir regulation activities and tributary flooding within the geographic boundaries of the Omaha District. The period covered by this report is 1 August 1994 through 31 July 1995 and is referred to as the report period.

II. REFERENCES.

a. ER 1110-2-1400, 24 April 1970.

b. ER 1110-2-240, 8 October 1982.

c. Missouri River Division Letter, 1 October 1970, Subject: Reservoir Regulation Reports.

d. HQUSACE Memorandum, 19 November 1995, Subject: Annual Division Water Control Management Report.

III. RESERVOIRS IN THE OMAHA DISTRICT. The Omaha District, Corps of Engineers, civil works boundaries include 414,900 square miles that comprise the Missouri River watershed upstream of Rulo, Nebraska.

a. Reservoirs with Flood Control Storage. There are 36 tributary reservoirs with allocated flood control storage covered in this report, including 25 Corps of Engineers dams and 11 Bureau of Reclamation dams. The Corps of Engineers and Bureau of Reclamation dams are listed on Table 1. The locations of the tributary reservoirs are shown on Plate 1 and pertinent data are presented on Plates 2-5. For information purposes, pertinent data for the Missouri River Mainstem Reservoirs are shown on Plate 6.

b. Reservoirs without Flood Control Storage. There are two Corps of Engineers tributary reservoirs without allocated flood control storage included in this report. Both are subimpoundments of the Missouri River Main Stem Projects and were formed by the construction of relocations for transportation facilities and utilities. Lake Audubon, a subimpoundment of Lake Sakakawea, is located just northeast of Riverdale, North Dakota. Lake Pocasse, a subimpoundment of Lake Oahe, is located near Pollock, South Dakota. Both lakes are used for fish and wildlife and recreational purposes. The two reservoirs are listed on Table 1, their locations are shown on Plate 1 and pertinent data are presented on Plates 2 and 4.

TABLE 1
CORPS OF ENGINEERS TRIBUTARY RESERVOIRS

Name of Dam	Location	River	Date of Closure	Drainage Area (sq mi.)	Exclusive Flood Control Storage (Acre-Feet)
1. Bear Creek	Denver, CO	Bear Creek	July 1977	236	28,757
2. Bowman-Haley	Bowman, ND	N. Fork Grand	August 1966	446	72,717
3. Bull Hook	Havre, MT	Bull Hook Creek	October 1955	54	6,500
4. Cedar Canyon	Rapid City, SD	Deadman Gulch	September 1959	0.4	123
5. Chatfield	Denver, CO	South Platte	August 1973	3,018	206,945
6. Cherry Creek	Denver, CO	Cherry Creek	October 1948	386	122,842
7. Cold Brook	Hot Springs, SD	Cold Brook	September 1952	70.5	6,680
8. Cottonwood Springs	Hot Springs, SD	Cottonwood Springs Creek	May 1969	26	7,730
9. Kelly Road	Denver, CO	Westerly Creek	November 1953	10.8	360
10. Papillion No. 11	Omaha, NE	Knight Creek	August 1974	17.8	13,899
11. Papillion No. 16	Omaha, NE	Big Papio Cr.	October 1972	6	3,720
12. Papillion No. 18	Omaha, NE	Boxelder Creek	July 1984	16.4	7,585
13. Papillion No. 20	Omaha. NE	S. Br. Papio Cr.	September 1982	13.1	6,119
14. Pipestem	Jamestown, ND	Pipestem Creek	July 1973	594	137,010
15. Salt Creek No. 2	Lincoln, NE	S. Olive Br.	September 1963	8.2	3,980
16. Salt Creek No. 4	Lincoln, NE	N. Olive Br.	September 1962	16.6	7,113
17. Salt Creek No. 8	Lincoln, NE	N. Hickman Br.	September 1962	15.6	6,790
18. Salt Creek No. 9	Lincoln, NE	S. Hickman Br.	August 1963	9.7	4,700
19. Salt Creek No. 10	Lincoln, NE	Cardwell Br.	October 1965	8.4	5,854
20. Salt Creek No. 12	Lincoln, NE	Holmes Creek	September 1963	15.1	8,030
21. Salt Creek No. 13	Lincoln, NE	Middle Creek	September 1965	11.0	5,250
22. Salt Creek No. 14	Lincoln, NE	N. Middle Creek	July 1964	35.9	20,290
23. Salt Creek No. 17	Lincoln, NE	Antelope Creek	September 1962	5.4	5,885
24. Salt Creek No. 18	Lincoln, NE	Oak Creek	August 1967	88.7	71,570
25. Westerly Creek	Denver, CO	Westerly Creek	October 1990	9.3	4,150
26. Spring Creek Dam (Lake Pocasse)	Pollock, SD	Spring Creek	1961	660	0
27. Snake Creek Dam (Lake Audubon)	Riverdale, ND	Snake Creek	1952	250	0

TABLE 1 (Con't)
BUREAU OF RECLAMATION TRIBUTARY RESERVOIRS

Name of Dam	Location	River	Date of Closure	Drainage Area (sq mi.)	Exclusive Flood Control Storage (acre-feet)
1. Boysen	Thermopolis, WY	Wind	October 1951	7,710	150,400
2. Canyon Ferry	Helena, MT	Missouri	March 1953	15,900	99,460
3. Clark Canyon	Dillon, MT	Beaverhead	August 1964	2,320	79,090
4. Glendo	Glendo, WY	North Platte	June 1956	14,330	271,900
5. Heart Butte	Glen Ullin, ND	Heart	August 1949	1,710	147,900
6. Jamestown	Jamestown, ND	James	May 1953	1,300	185,400
7. Keyhole	Moorcroft, WY	Belle Fourche	March 1952	1,950	140,500
8. Pactola	Rapid City, SD	Rapid Creek	August 1956	319	43,057
9. Shadehill	Shadehill, SD	Grand	July 1950	3,120	218,300
10. Tiber	Chester, MT	Marias	October 1950	4,850	400,900
11. Yellowtail .	Hardin, MT	Bighorn	December 1966	19,626	258,330

IV. TRIBUTARY RUNOFF AND FLOODING.

a. General Basin Runoff and Flooding. Missouri River tributary flows during the report period were near normal or above normal in most of the basin. The Long Term Palmer Drought Severity maps for the ends of water years 1992 through 1995 are shown on Plates 7 and 8. The drought that was prevalent across the Rocky Mountain states at the beginning of water year 1995 was erased, largely by late-season heavy snowfall. By the end of water year 1995, the entire District was rated as normal or moist.

Within the Omaha District, the period of August 1994 through July 1995 saw the potential for extensive flooding with an above normal snowpack in the Rocky Mountains of Colorado, Wyoming, and Montana, and a cool, wet spring in Iowa and Nebraska that left antecedent conditions for flooding on par with the flood of 1993. North Dakota and South Dakota experienced extensive flooding that was worse than flooding in 1993. Fortunately, the reservoirs in the Rocky Mountain states minimized flooding in the downstream states and the weather turned warm and dry for the plains preventing additional flooding. The following paragraphs give a general overview of the flooding that occurred in each state within the Omaha District. This information was taken from the National Weather Service's Monthly Report of River and Flood Conditions.

(1) Montana. Montana experienced an above average snowpack in the mountains for this reporting period. Warm temperatures in February and March on the snowpack caused some localized flooding in Ennis and Dillon, MT. However, starting in May, heavy rains fell on the large snowpack causing many small streams to come out of their banks. The rain continued to fall on the snowpack through early June. Most creeks and rivers having headwaters in the northern Rockies had some degree of flooding lasting through the first half of June. This included flooding on the Jefferson, Gallatin and Big Hole Rivers. A lot of nuisance flooding occurred with water over roads and up to homes.

During June, the Missouri River overflowed its banks from its headwaters to Toston, MT. However, Canyon Ferry Reservoir was able to store most of the water, preventing flooding downstream.

(2) Wyoming. Similar to the Rocky Mountains in Montana, Wyoming experienced above normal basin precipitation during the spring from April through June. This produced an above normal mountain snowpack throughout the whole state of Wyoming and set records for several of the mountain ranges. By mid-June, above normal temperatures and heavy rainfall resulted in rapid melting of the snowpack causing minor lowland flooding along the North Platte and Laramie Rivers. Flooding was minimized by controlled releases from Grayrocks and Glendo Reservoirs.

(3) North Dakota. For this reporting period, North Dakota experienced an extremely wet year. Significant snowfall in the winter followed by above average temperatures in March caused widespread flooding. Above average rainfall through the spring and summer of 1995 throughout the state caused additional flooding. Due to the widespread flooding, a Presidential Disaster Declaration was made for 32 of the 53 counties in North Dakota. Within the Omaha District, this included all of the counties downstream of Garrison Dam and to the east of the Missouri River and included the James River basin.

On the Missouri River, Williston was above flood stage during June and July of 1995. These high stages were caused by the above normal snowmelt in the mountains, heavy rainfall in early summer, and the high reservoir levels of both Fort Peck and Garrison Reservoirs.

(4) South Dakota. Like North Dakota, South Dakota experienced late winter snowstorms and a very wet spring that produced state wide flooding that lasted through June. Thirty-eight counties received a Presidential Disaster Declaration as a result of the floods and severe late-winter storms. This included most of the eastern half of the state and several counties in the Black Hills region. Between March and May 1995, thirty-two USGS streamflow gages throughout South Dakota experienced record stages.

The most significant rainfall event in South Dakota during the period covered occurred from May 7 through 10 with the Black Hills receiving between three and six inches, with some places reporting from six to ten inches. This caused flash flooding over several counties and caused widespread damage to roads and bridges along with basement flooding to many homes.

By July, only the northern portions of the James River were still experiencing flood stages. The high stages will likely continue for the James River north of Stratford, SD due to water stored in the many lakes and potholes in North Dakota and with releases from Jamestown and Pipestem Reservoirs.

(5) Iowa. Northwest Iowa experienced the same weather that afflicted South Dakota with flooding on many of the tributaries that prevented farmers from planting their crops. However, this ended in early summer and no additional flooding occurred. For Southwest Iowa, a cooler and wetter than normal spring made the antecedent conditions very wet. Fortunately, June and July were dry which helped return soil moisture conditions back near normal.

(6) Colorado. Similar to the other Rocky Mountain states in the Omaha District, Colorado experienced above normal basin precipitation during the spring, producing above normal mountain snowpack. By mid-June, above normal temperatures and heavy rainfall resulted in rapid melting of the snowpack, causing minor lowland flooding along the South Platte River. Flooding was minimized by controlled releases from Cherry Creek, Bear Creek, and Chatfield Reservoirs.

(7) Nebraska. Nebraska began winter with below normal precipitation and above normal temperatures. However, this reversed itself in March and continued through May as above normal precipitation caused localized flooding and put antecedent conditions at very wet. By June, precipitation dropped below normal and temperatures were above normal allowing for streams to recede and soil moisture conditions to return to normal.

The North and South Platte Rivers and the main Platte River experienced flooding during May and June due to the delayed mountain snowmelt and locally heavy rainfall in Colorado and Wyoming. Lake McConaughy held back substantial flows, preventing flooding on the lower reaches of the North Platte River and helped minimize the flooding on the main Platte River. The Platte River was back within its banks by July.

The high flows from the Platte River, the northwest Iowa and southeast South Dakota tributaries, along with some local runoff of nearby tributaries caused the Missouri River to go out of bank and cause minor flood damage downstream of Omaha from late May to early June.

b. Runoff Into Tributary Reservoirs. In the Omaha District, high antecedent moisture conditions, along with high snowmelt and rainfall runoff produced runoff as high as 770 percent of normal and record pools on 5 projects.

Table 2 lists runoff and peak pool statistics for each project during the report period. Table 3 lists peak discharges at selected gaging stations including many reservoir release control points used by the Omaha District.

TABLE 2
RUNOFF AMOUNTS AND PEAK POOL LEVELS

NAME OF DAM	1995 (1) INFLOW ACRE-FEET	PREVIOUS (2) PEAK INFLOW (ACRE-FEET)	AVERAGE INFLOW ACRE-FEET	% OF NORMAL	1995 PEAK POOL	PREVIOUS PEAK POOL
Bowman-Haley Dam	46,520	165,993	20,237	189	2757.8	2747.6 (82)
Bear Creek Dam	67,275	91,923	36,140	186	5587.2	5581.01 (83)
Chatfield Dam	314,540	450,443	163,360	193	5446.4	5447.6 (80)
Cherry Creek Dam	11,113	30,923	5,050	220	5551.0	5565.8 (73)
Cold Brook Dam	674	1,066	564	123	3585.4	3585.4 (94)
Cottonwood Dam	n/a	n/a	n/a	n/a	3862.1	3861.0 (94)
Kelly Road Dam	n/a	n/a	n/a	n/a	n/a	n/a
Papio Dam 11	6,802	18,651	7,640	89	1122.4	1124.4 (84)
Papio Dam 16	1,035	3,187	1,140	91	1105.0	1107.8 (84)
Papio Dam 18	5,304	10,598	5,060	105	1112.0	1116.8 (93)
Papio Dam 20	2,524	9,528	2,260	112	1098.4	1130.2 (93)
Pipestem Dam	145,352	145,884	33,060	437	1479.5	1472.6 (93)
Salt Creek Dam 2	4,634	12,508	2,370	196	1338.4	1342.6 (93)
Salt Creek Dam 4	10,408	14,889	4,420	235	1311.7	1316.5 (73)
Salt Creek Dam 8	8,345	12,042	4,540	184	1291.6	1295.4 (73)
Salt Creek Dam 9	6,336	10,415	2,960	265	1274.8	1279.0 (73)
Salt Creek Dam 10	7,461	15,785	5,250	142	1249.5	1252.3 (73)
Salt Creek Dam 12	4,695	25,014	5,825	81	1236.6	1241.1 (87)
Salt Creek Dam 13	4,126	13,015	4,200	98	1343.0	1346.9 (83)

(1) Report Period Aug 1 - Jul 31
(2) Water Year Oct 1 - Sep 30

NAME OF DAM	1995 (1) INFLOW ACRE-FEET	PREVIOUS (2) PEAK INFLOW (ACRE-FEET)	AVERAGE INFLOW ACRE-FEET	% OF NORMAL	1995 PEAK POOL	PREVIOUS PEAK POOL
Salt Creek Dam 14	7,675	27,239	8,220	93	1246.0	1249.9 (79)
Salt Creek Dam 17	7,323	10,003	2,790	263	1244.9	1250.0 (93)
Salt Creek Dam 18	45,216	74,415	30,240	150	1286.6	1287.9 (87)
Spring Creek Dam (Lake Pocasse)	n/a	n/a	n/a	n/a	1623.0	1625.0 (87)
Snake Creek Dam (Lake Audubon)	n/a	n/a	n/a	n/a	1847.1	1848.6 (76)
Westerly Creek Dam	n/a	n/a	n/a	n/a	n/a	n/a
BUREAU OF RECLAMATION						
Boysen Dam	1,438,979	1,676,589	1,021,797	142	4728.0	4730.8 (67)
Canyon Ferry Dam	5,174,160	5,769,196	398,151	129	3798.9	3800.0 (62)
Clark Canyon Dam	332,397	718,126	281,310	117	5553.7	5564.7 (84)
Glendo Dam	1,137,790	2,233,437	1,190,998	98	4641.7	4650.9 (73)
Heart Butte Dam	81,055	306,877	93,572	87	2067.4	2086.2 (52)
Jamestown Dam	201,231	194,243	32,187	770	1442.9	1444.1 (69)
Keyhole Dam	36,095	100,319	32,763	110	4088.8	4100.4 (78)
Pactola Dam	57,677	73,069	33,190	171	4583.3	4585.9 (65)
Shadehill Dam	166,663	227,844	73,959	218	2275.8	2297.9 (52)
Tiber Dam	755,162	1,149,544	660,580	113	2995.3	3005.6 (65)
Yellowtail Dam	2,492,481	3,458,752	2,474,136	101	3646.3	3656.4 (67)

TABLE 3
PROVISIONAL 1995 WATER YEAR PEAK STAGES AND DISCHARGES

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
Red Rock River	below Lima Res, MT	570	1911	1.1	26 Jun 95	3.93	809		15 May 1993	5.40	2,500
Beaverhead River	nr Twin Bridges, MT	3,619	1935	5.2	14 Jul 95	6.93	1,420		12 May 1944	nr	3,130
Jefferson River	nr Three Forks, MT	9,532	1978	na	09 Jun 95	3.00	17,000		24 May 1981	8.06	15,900
Madison River	nr McAllister, MT	2,186	1901	4.4	07 Jun 95	6.76	6,470		12 Jun 1970	8.01	9,550
Gallatin River	@ Logan, MT	1,795	1893	7.5	06 Jun 95	8.67	7,220		21 Jun 1899	nr	9,840
Missouri River	@ Toston, MT	14,669	1890	10	08 Jun 95	11.12	27,300		06 Jun 1948	11.77	32,000
Missouri River	nr Ulm, MT	20,941	1957	13	14 Jun 95	12.00	19,000		01 Jun 1953	17.00	35,000
Sun River	nr Vaughn, MT	1,854	1897	10	07 Jun 95	9.05	5,590		09 Jun 1964	23.40	53,500
Missouri River	@ Virgelle, MT	34,379	1935	17	10 Jun 95	9.85	30,200		05 Jun 1953	23.40	122,000
Missouri River	nr Landusky, MT	40,987	1934	na	11 Jun 95	23.87	34,600		06 Jun 1953	nr	137,000
Milk River	@ Havre, MT	5,785	1899	10	06 Jun 95	5.64	1,750		12 Apr 1899	nr	20,000
Milk River	nr Saco, MT	17,670	1977	20	12 Jun 95	8.65	2,570		03 Apr 1979	24.20	12,400
Milk River	@ Nashua, MT	22,332	1939	20	26 Jun 95	10.40	3,500		18 Apr 1952	31.38	45,300
Missouri River	nr Wolf Point, MT	82,290	1928	10.9	01 Sep 94	3.34	10,200		25 Mar 1939	14.40	66,800
Missouri River	nr Culbertson, MT	91,557	1941	19	03 Sep 94	5.65	9,640		26 Mar 1943	15.12	78,200
Musselshell River	nr Roundup, MT	4,023	1946	5.1	10 Jun 95	5.52	1,990		18 Jun 1967	12.45	9,610
Yellowstone River	@ Billings, MT	11,795	1904	13	07 Jun 95	12.33	50,600		01 Apr 1905	nr	78,100

* = backwater
nr = not rated
na = not available

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
Wind River	@ Riverton, WY	2,309	1906	8	17 Jun 95	9.96	7,680		15 Jun 1935	10.15	13,300
Wind River	below Boysen Res, WY	7,701	1951	na	16 Jul 95	11.26	9,740		07 Jul 1967	13.35	13,500
Bighorn River	@ Kane, WY	15,765	1928	8	17 Jun 95	8.64	15,700		16 Jun 1935	11.10	25,200
Bighorn River	@ Bighorn, MT	22,414	1955	17	16 Jun 95	9.62	13,700		20 May 1978	nr	59,200
Yellowstone River	@ Miles City, MT	48,253	1922	13	18 Jun 95	11.39	54,100		22 May 1978	16.50	102,000
Tongue River	@ Miles City, MT	5,379	1938	5.8	14 May 95	6.98	3,650		15 Jun 1962	11.33	13,300
Powder River	nr Locate, MT	13,194	1938	8.4	13 May 95	8.05	11,900		19 Feb 1943	11.23	31,000
Yellowstone River	nr Sidney, MT	69,103	1910	19	11 Jun 95	15.39	58,800		21 Jun 1921	nr	159,000
Knife River	@ Hazen, ND	2,240	1928	12	22 Feb 95	21.87	5,680*		24 Jun 1966	27.01	35,300
Missouri River	@ Bismarck, ND	186,400	1927	16	20 Jan 95	12.78	24,800	13.31 16 Dec 94	06 Apr 1952	27.90	500,000
Heart River	nr Mandan, ND	3,310	1924	17	14 Mar 95	19.89	10,800*		19 Apr 1950	23.64	30,500
Cannonball River	@ Breien, ND	4,100	1934	10	13 Mar 95	12.44	8,760*		19 Apr 1950	22.30	94,800
N Fork Grand River	@ Haley, ND	509	1908	17	14 May 95	10.82	1,380		07 Apr 1952	17.03	14,100
Grand River	@ Little Eagle, SD	5,370	1958	15	14 Mar 95	13.84	12,800	14.92 22 Feb 95	23 Mar 1987	19.16	31,000
Moreau River	nr Whitehorse, SD	4,880	1954	21	13 May 95	17.83	10,600		24 May 1982	26.00	27,700
Belle Fourche River	@ WY-SD State Line	3,280	1946	14	10 May 95	16.33	6,320		18 Jun 1962	15.59	4,400
Fall River	@ Hot Springs, SD	137	1937	13	03 Jun 95	2.98	70.3		04 Sep 1938	18.40	13,100
Rapid Creek	@ Rapid City, SD	410	1942	7	21 Jun 95	5.17	746		09 Jun 1972	19.66	50,000
Cheyenne River	nr Wasta, SD	12,800	1928	16	10 Jun 95	10.30	17,300		06 May 1932	13.28	46,300

* = backwater
nr = not rated
na = not available

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
Cheyenne River	nr Howes *, SD	23,900	1960	14	10 May 95	19.72	35,000		22 May 1982	15.77	55,900
Bad River	nr Ft. Pierre, SD	3,107	1928	21	09 May 95	23.61	14,500		01 Jul 1905	32.90	70,000
Niobrara River	nr Verdel, NE	12,600	1958	12	28 May 95	5.58	20,000		27 Mar 1960	10.10	39,000
Vermillion River	nr Vermillion, SD	2,302	1983	21	04 Jun 95	19.49	4,080		23 Jun 1984	31.77	21,400
Pipestem Creek	nr Pingree, ND	700	1973	10	16 Sep 94	11.02	1,470	11.75 17 Mar 95	20 Apr 1979	11.60	2,520
James River	nr Grace City, ND	1,060	1968	12	19 Mar 95	13.13	2,590*		28 Jul 1993	13.82	3,786
James River	@ Jamestown, ND	2,820	1928	12	08 Jul 95	10.78	1,470		13 May 1950	15.82	6,390
James River	@ Lamoure, ND	4,390	1957	14	13 May 95	11.34	2,770	13.32 18 Mar 95	14 Apr 1969	16.17	6,800
James River	@ Columbia, SD	7,393	1988	11	22 May 95	16.95	1,660*	18.50 13 May 95	24 May 1950	16.89	5,420
James River	@ Ashton, SD	9,742	1945	13	22 May 95	21.21	4,500*	22.39 18 May 95	24 Apr 1969	20.63	5,680
James River	nr Scotland, SD	20,653	1928	13	29 May 95	19.41	18,200		23 Jun 1984	20.45	29,400
Big Sioux River	nr Watertown, SD	1,007	1972	6.8	12 Mar 95	9.81	2,000*		30 Mar 1986	11.08	4,970
Big Sioux River	nr Dell Rapids, SD	4,483	1948	12	22 Apr 95	14.12	8,920		09 Apr 1969	16.47	41,300
Skunk Creek	@ Sioux Falls, SD	622	1948	na	18 Apr 95	6.75	3,520		17 Jun 1957	nr	29,400
Big Sioux River	@ Sioux Falls, SD	5,216	1962	16	23 Apr 95	18.90	8,490		10 Apr 1969	27.45	40,700
Rock River	nr Rock Valley, IA	1,592	1948	16	29 May 95	12.27	6,740		07 Apr 1969	17.32	40,400
Big Sioux River	@ Akron, IA	8,424	1928	16	22 Apr 95	20.88	22,200		09 Apr 1969	22.99	80,800
Missouri River	@ Sioux City, IA	314,600	1897	36	01 Jun 95	25.14	65,900		14 Apr 1952	24.28	441,000
Perry Creek	@ Sioux City, IA	65	1945	15.5	28 May 95	12.65	1,280		19 May 1990	28.54	8,670

* = backwater
nr = not rated
na = not available

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
Floyd River	@ Alton, IA	268	1955	12	08 Aug 95	15.05	2,750		20 Jun 1983	18.54	16,300
Floyd River	@ James, IA	886	1934	26	29 May 95	16.25	3,570		08 Jun 1953	25.30	71,500
Missouri River	@ Decatur, NE	316,200	1987	23.2	02 Jun 95	30.10	64,900		16 Jul 1993	32.04	75,402
Little Sioux River	@ Linn Grove, IA	1,548	1927	20	17 May 95	15.28	4,680		02 Jul 1993	20.69	17,399
Little Sioux River	@ Correctionville, IA	2,500	1918	19	19 May 95	13.96	5,530		07 Apr 1965	25.86	29,800
West Fork Ditch	@ Hornick, IA	403	1939	20	28 May 95	15.08	1,970		28 Mar 1962	22.46	12,400
Little Sioux River	nr Turin, IA	3,526	1958	20	30 May 95	16.43	7,670		21 Jun 1983	26.54	31,200
Maple River	@ Mapleton, IA	689	1941	16	28 May 95	4.75	2,100		12 Sep 1978	16.74	20,800
Soldier River	@ Pisgah, IA	407	1940	26	11 Mar 95	9.31	2,700		12 Jun 1950	28.17	22,500
Boyer River	@ Logan, IA	871	1918	19	11 Mar 95	11.27	6,150		17 Jun 1990	22.54	30,800
Missouri River	@ Omaha, NE	322,800	1928	29	03 Jun 95	26.31	81,100		18 Apr 1952	40.20	396,000
Missouri River	@ Nebraska City, NE	410,000	1929	28	03 Jun 95	21.35	109,000		19 Apr 1952	27.66	414,000
West Nishnabotna River	@ Hancock, IA	609	1959	14	12 Mar 95	8.10	3,220		02 Apr 1993	24.76	29,257
West Nishnabotna River	@ Randolph, IA	1,326	1948	19	10 May 95	14.72	5,680		26 May 1987	24.50	40,800
East Nishnabotna River	nr Atlantic, IA	436	1960	17	28 May 95	8.45	2,920		12 Sep 1972	22.81	26,700
East Nishnabotna River	@ Red Oak, IA	894	1918	18	26 Mar 95	13.30	5,960		13 Sep 1972	27.43	38,000
Nishnabotna River	above Hamburg, IA	2,806	1922	36	10 May 95	22.86	14,500		24 Jun 1947	26.03	55,500
Missouri River	@ Rulo, NE	414,900	1949	17	13 May 95	22.41	127,000		22 Apr 1952	25.60	358,000
North Platte River	nr Sinclair, WY	4,175	1939	19	19 Jun 95	9.51	11,700		11 Jun 1986	11.30	16,200

* = backwater
nr = not rated
na = not available

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
North Platte River	nr Glenrock, WY	13,538	1959	4.5	09 May 95	4.76	5,450		14 May 1965	7.10	16,000
North Platte River	below Walen Res, WY	16,425	1909	4.5	28 May 95	8.46	4,300		26 Jun 1955	9.85	22,000
Laramie River	nr Ft. Laramie, WY	4,564	1915	na	11 Jun 95	7.54	3,110		10 May 1973	9.40	6,260
North Platte River	@ WY-NE State Line	22,218	1929	4.5	12 Jun 95	5.72	5,660		02 Jun 1929	nr	17,900
North Platte River	@ Bridgeport, NE	25,300	1905	8	12 Jun 95	10.54	7,120		26 Jun 1899	5.39	24,900
North Platte River	@ Lewellen, NE	28,600	1937	7	11 Jun 95	7.77	7,240		04 Jun 1971	nr	13,500
North Platte River	@ North Platte, NE	30,900	1895	7	18 Jul 95	5.72	3,110		11 Jun 1909	nr	29,600
South Platte River	nr Hartsel, CO	880	1933	na	17 Jun 95	3.22	615		27 Apr 1970	7.60	3,970
South Platte River	@ Waterton, CO	2,621	1928	6	20 Jun 95	4.13	3,460		23 Apr 1942	5.68	5,700
N. Fk South Platte River	@ Grant, CO	127	1906	na	18 Jun 95	2.48	1,160		07 Jun 1912	nr	990
Bear Creek	@ Sheridan, CO	260	1914	8	17 Jun 95	4.74	607		07 May 1969	10.50	8,150
Bear Creek	@ Morrison, CO	164	1887	7.5	18 Jun 95	6.53	813		24 Jul 1896	nr	8,600
South Platte River	@ Denver, CO	3,861	1889	9	28 Jun 95	8.75	5,740		17 Jun 1965	18.66	40,300
Clear Creek	@ Golden, CO	400	1974	7	18 Jun 95	8.05	2,670		10 Jul 1983	6.44	2,370
Clear Creek	@ Derby, CO	575	1916	8	18 Jun 95	4.50	2,390	major control change	24 Jul 1965	8.97	5,070
South Platte River	@ Henderson, CO	4,713	1926	11	09 Jun 95	8.84	8,670		06 May 1973	11.67	33,000
South Platte River	nr Kersey, CO	9,598	1901	10	31 May 95	10.99	21,500		08 May 1973	11.73	31,500
South Platte River	@ Julesburg, CO	23,193	1902	10	11 Jun 95	9.44	13,700		20 Jun 1965	10.44	37,600
South Platte River	@ North Platte, NE	24,300	1897	12	07 Jun 95	12.99	14,400		03 Jun 1935	14.02	37,100

* = backwater
nr = not rated
na = not available

Stream	Station	Drainage Area (Sq Mi)	Record Since	Flood Stage	Maximum 1995				Maximum Known		
					Date	Stage	Discharge (cfs)	Comments/ Alternate Date	Date	Stage	Discharge (cfs)
Platte River	@ Brady, NE	56,200	1935	5	14 Jun 95	8.70	15,675		29 Jun 1983	nr	23,500
Platte River	nr Kearney, NE	58,200	1982	6	11 Jun 95	7.40	19,250		29 Jun 1983	7.42	23,700
Platte River	nr Grand Island, NE	58,800	1933	4	12 Jun 95	5.41	16,160		06 Jun 1935	5.99	30,000
Middle Loup River	@ St. Paul, NE	8,090	1894	8	28 May 95	5.21	14,900		23 Jun 1947	nr	72,000
North Loup River	@ St. Paul, NE	4,290	1894	5.5	27 May 95	5.32	6,160		06 Jun 1896	nr	90,000
Elkhorn River	@ Norfolk, NE	2,790	1945	10	31 May 95	13.05	19,200		14 Jun 1967	8.52	16,900
Elkhorn River	@ West Point, NE	5,100	1940	12	01 Jun 95	12.67	19,000		09 Mar 1993	19.30	90,658
Elkhorn River	@ Waterloo, NE	6,900	1928	17	29 May 95	12.32	22,400		12 Jun 1944	16.60	100,000
Platte River	@ North Bend, NE	77,100	1949	8	28 May 95	7.43	32,200		29 Mar 1960	10.04	112,000
Platte River	@ Louisville, NE	85,600	1953	9	29 May 95	9.12	70,500		24 Jul 1993	12.12	164,231
Logan Creek	nr Uehling, NE	1,030	1941	16	28 May 95	18.50	11,200		20 Feb 1971	20.15	25,200
Salt Creek	@ Lincoln, NE	646	1940	20.5	06 May 95	14.56	8,590		19 Jul 1986	18.24	8,000
Salt Creek	@ Greenwood, NE	1,051	1951	20	n/a	n/a	n/a		13 Jun 1984	26.50	46,800
Little Papillion Creek	@ Irvington, NE	32	1948	17	22 May 95	6.09	167		03 Jun 1943	23.00	nr
Big Papillion Creek	@ Fort Street, NE	126	1966	na	22 May 95	10.55	1,690		17 Feb 1966	30.51	nr
Papillion Creek	@ Fort Crook, NE	384	1948	29	11 Jul 95	28.03	7,720		21 May 1982	30.68	12,700

* = backwater
nr = not rated
na = not available

V. RESERVOIR ACCOMPLISHMENTS.

a. Flood Damages Prevented. Flood damages prevented by Corps of Engineers Mainstem Reservoirs, Tributary reservoirs and local protection projects and Bureau of Reclamation projects in FY95 and cumulative totals of flood damage prevented for each of the projects are summarized in Table 4. Flood damages prevented in each state are shown in Table 5.

b. Recreation Usage. Visitation hours for each Corps of Engineers project for FY92, FY93, FY94 and FY95 are tabulated in Table 6.

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TABLE 4

FLOOD DAMAGES PREVENTED FY 1995
CORPS OF ENGINEERS, OMAHA DISTRICT PROJECTS
LOCAL AND MAIN STEM REDUCTIONS ($000)

SOURCE: WORK SHEETS

Omaha District Projects	Reach Location	Cumulative Thru FY 94	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	Total FY 1995	Cumulative Thru FY 95
Missouri River Reservoirs	MRO	1,230,186.3	0.0	0.0	0.0	90,483.5	0.0	0.0	90,483.5	1,320,669.8
Other Reservoir Projects										
Aurora Dam/D.S. Chanl. Impr.	CO	7,413.2							0.0	7,413.2
Bear Creek Dam	CO	1,407.6				729.4			729.4	2,137.0
Bowman-Haley Dam	ND/SD	6,383.8							0.0	6,383.8
Chatfield Dam	CO	4,765.0				787.5			787.5	5,552.5
Cottonwood Springs Dam	SD	0.0							0.0	0.0
Cherry Creek Dam	CO	163,349.3				92.9			92.9	163,442.2
Cold Brook Dam	SD	0.0							0.0	0.0
Papillion Creek Dams/Chnl. Im.	NE	8,025.4							0.0	8,025.4
Pipestem Dam	ND	23,341.4	1,622.8						1,622.8	24,964.2
Salt Creek Dams/Levees	NE	79,795.9							0.0	79,795.9
Subtotal:		294,481.6	1,622.8	0.0	0.0	1,609.8	0.0	0.0	3,232.6	297,714.2
Missouri River Levee System										
L-601	IA	85,213.1	0.0	0.0	0.0	4,719.6	0.0	0.0	4,719.6	89,932.7
L-594	IA	60,537.1	0.0	0.0	0.0	3,337.4	0.0	0.0	3,337.4	63,874.5
L-575	IA/MO	74,523.9	0.0	0.0	0.0	1,421.3	0.0	0.0	1,421.3	75,945.2
L-561/L-550	MO	58,350.8	0.0	0.0	0.0	1,214.4	0.0	0.0	1,214.4	59,565.2
L-536	MO	16,963.7	0.0	0.0	0.0	332.4	0.0	0.0	332.4	17,296.1
R-613	NE	18,556.6	0.0	0.0	0.0	1,036.7	0.0	0.0	1,036.7	19,593.3
R-573	NE	3,133.3	0.0	0.0	0.0	61.1	0.0	0.0	61.1	3,194.4
R-562	NE	9,040.8	0.0	0.0	0.0	190.0	0.0	0.0	190.0	9,230.8
R-548	NE	6,780.7	0.0	0.0	0.0	132.3	0.0	0.0	132.3	6,913.0
R-520	NE	1,902.4	0.0	0.0	0.0	40.7	0.0	0.0	40.7	1,943.1
Subtotal:		335,002.4	0.0	0.0	0.0	12,485.7	0.0	0.0	12,485.7	347,488.1
Local Protection Projects										
Belle Fourche R. @ B. F.	SD	380.0							0.0	380.0
Big Sioux R. @ Sioux City	IA	102.1							0.0	102.1
Blackbird Creek @ Macy	NE	342.5							0.0	342.5
Broken Bow, Mud Creek	NE	108.0							0.0	108.0
Clarkson, Maple Ck.	NE	707.8				949.4			949.4	1,657.2
Columbus, Loup River	NE	15,508.5							0.0	15,508.5
Council Bluffs, Missouri R.	IA	464,373.0	0.0	0.0	0.0	21,067.2	0.0	0.0	21,067.2	485,440.2
Deadman Gulch @ Sturgis	SD	0.0			5,792.1				5,792.1	5,792.1
Emerson, Indian Creek	IA	0.0							0.0	0.0
Floyd River @ Sioux City	IA	27,441.0							0.0	27,441.0
Forsyth, Yellowstone R.	MT	1,849.1							0.0	1,849.1
Gering Valley	NE	1,115.4				11.1			11.1	1,126.5
Glasgow, Milk R.	MT	1,326.0							0.0	1,326.0
Great Falls, Sun R.	MT	0.0							0.0	0.0
Greybull, Bighorn R.	WY	5,689.2	171.0			836.9			1,007.9	6,697.1
Hamburg, Nishabotna R.	IA	112,124.5			1,285.7				1,285.7	113,410.2
Havre, Milk R.	MT	25,063.8							0.0	25,063.8
Hawarden, Dry Creek	IA	552.0							0.0	552.0

FILENAME: COEDAM

TABLE 4 (Con't)

FLOOD DAMAGES PREVENTED FY 1995
CORPS OF ENGINEERS, OMAHA DISTRICT PROJECTS
LOCAL AND MAIN STEM REDUCTIONS ($000)

Omaha District Projects	Reach Location	Cumulative Thru FY 94	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	Total FY 1995	Cumulative Thru FY 95
Herreid, Spring Creek	SD	33.0							0.0	33.0
Hooper, Elkhorn R.	NE	2,635.2							0.0	2,635.2
Hot Springs, Fall R.	SD	0.0							0.0	0.0
Ida Grove, Maple R.	IA	855.1			105.8				105.8	960.9
Kenslers Bend	SD/NE	36,326.0						914.0	914.0	37,240.0 **
Little Papillion Ck. @ Omaha	NE	4,475.7							0.0	4,475.7
Little Sioux River	IA	164,980.0			84.5				84.5	165,064.5
Lodgepole Ck. @ Sidney	NE	0.0							0.0	0.0
Lost Creek @ Columbus	NE	0.0							0.0	0.0
Madison, Union/Taylor Cks.	NE	4,588.6						202.3	202.3	4,790.9
Mandan, Heart R.	ND	32,729.8	745.4						745.4	33,475.2
Marmarth, Little Missouri R.	ND	1,449.0							0.0	1,449.0
Meadow Grove, Buffalo Ck.	NE	49.0						684.6	684.6	733.6
Norfolk, Elkhorn River	NE	9,437.0				9,944.3		1,738.9	11,683.2	21,120.2
Omaha, Missouri River	NE	427,773.2	0.0	0.0	0.0	18,367.2	0.0	0.0	18,367.2	446,140.4
Pebble Ck. @ Scribner	NE	12,200.6							0.0	12,200.6
Pierce, N. F. Elkhorn R.	NE	943.7	14.9						14.9	958.6
Platte R. @ Schuyler	NE	2,068.9							0.0	2,068.9
Red Dale Gulch	SD	250.0							0.0	250.0
Red Oak, E. Nishnabotna R.	IA	10,000.8							0.0	10,000.8
Saco, Beaver Ck.	MT	987.8							0.0	987.8
Schuyler, Lost Ck.	NE	394.0							0.0	394.0
Scranton, Buffalo Ck.	ND	0.0							0.0	0.0
Sheridan, Goose Ck.	WY	741.0							0.0	741.0
Shields R. @ Clyde Park	MT	156.0							0.0	156.0
Sioux Falls, Big Sioux R.	SD	17,509.3		117.8					117.8	17,627.1
Vaughn, Sun R.	MT	485.0							0.0	485.0
Waterloo, Elkhorn R.	NE	470.0							0.0	470.0
W. Glendive, Yellowstone R.	MT	2,136.2							0.0	2,136.2
West Point, Elkhorn R.	NE	16,454.8							0.0	16,454.8
Subtotal:		1,406,812.6	931.3	117.8	7,268.1	51,176.1	0.0	3,539.8	63,033.1	1,469,845.7
Other Projects										
McCook Lake	SD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 ***
Total Corps Projects:	MRO	3,266,482.9	2,554.1	117.8	7,268.1	155,755.1	0.0	3,539.8	169,234.9	3,435,717.8

* Includes Missouri River Levees L-627 and L-624.

** Based on estimates of annual benefits. Project serves other than flood control purposes.

*** $433,000 recreational benefits cumulative at the rate of $11,000 annually.

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"OCT 1995"

TABLE 4 (Con't)
FLOOD DAMAGES PREVENTED FY 1995
BUREAU OF RECLAMATION, OMAHA DISTRICT PROJECTS
LOCAL AND MAIN STEM REDUCTIONS ($000)

River Basin	Omaha District Projects	Reach Location	Cumulative Thru FY 94	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	Total FY 1995	Cumulative Thru FY 95
Big Horn River	Boysen	WY	42,401.9	0.0	0.0	0.0	1,136.1	0.0	0.0	1,136.1	43,538.0
	Buffalo Bill	WY	3,204.5	0.0	0.0	0.0	1.9	0.0	0.0	1.9	3,206.4
	Bull Lake	WY	1,993.9	0.0	0.0	0.0	244.8	0.0	0.0	244.8	2,238.7
	Yellowtail	MT	51,654.3	0.0	0.0	0.0	2,055.2	0.0	0.0	2,055.2	53,709.5
		Subtotal:	99,254.6	0.0	0.0	0.0	3,438.0	0.0	0.0	3,438.0	102,692.6
Cheyenne River	Angostura	SD	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4
	Keyhole	WY/SD	2,816.5	0.0	0.0	0.6	575.5	0.0	0.0	576.1	3,392.6
	Pactola	SD	1,737.2	0.0	0.0	199.4	79.4	0.0	0.0	278.8	2,016.0
		Subtotal:	4,574.1	0.0	0.0	200.0	654.9	0.0	0.0	854.9	5,429.0
Grand River	Shadehill	SD	8,012.5	0.0	0.0	0.0	258.0	0.0	0.0	258.0	8,270.5
Heart River	Heart Butte	ND	12,038.0	24.4	0.0	0.0	39.7	0.0	0.0	64.1	12,102.1
James River	Jamestown	ND	35,955.8	9,556.5	0.0	0.0	0.0	0.0	0.0	9,556.5	45,512.3
Marias River	Tiber	MT	43,027.0	0.0	0.0	0.0	4,956.1	0.0	0.0	4,956.1	47,983.1
Milk River	Fresno	MT	7,266.8	0.0	0.0	0.0	59.4	0.0	0.0	59.4	7,326.2
Missouri River	Canyon Ferry	MT	83,723.4	0.0	0.0	0.0	2,623.1	0.0	0.0	2,623.1	86,346.5
North Platte River	Pathfinder	WY	5,328.1	0.0	0.0	0.0	1,571.5	0.0	0.0	1,571.5	6,899.6
	Alcova	WY	226.2	0.0	0.0	0.0	46.0	0.0	0.0	46.0	272.2
	Seminoe	WY	13,205.5	0.0	0.0	0.0	5,765.3	0.0	0.0	5,765.3	18,970.8
	Guernsey	WY	439.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	439.0
	Glendo	WY/NE	38,996.7	0.0	0.0	0.0	3,700.1	0.0	0.0	3,700.1	42,696.8
		Subtotal:	58,195.5	0.0	0.0	0.0	11,082.8	0.0	0.0	11,082.8	69,278.3
Sun River	Gibson	MT	2,927.6	0.0	0.0	101.7	0.0	0.0	0.0	101.7	3,029.3
Threeforks Basin	Clark Canyon	MT	7,397.2	0.0	0.0	0.0	1,069.4	0.0	0.0	1,069.4	8,466.6
Total Bureau Projects:			362,372.5	9,580.9	0.0	301.7	24,181.5	0.0	0.0	34,064.1	396,436.6

TABLE 5
FY95 FLOOD DAMAGES PREVENTED, OMAHA DISTRICT (x $1,000)

State	Main Stem Dams	Main Stem Urban Levees	Main Stem Nonurban Levees	Bur. Rec. Dams (Main Stem)	Bureau of Reclamation Dams (Local)*	Corps Local Protection Dams**	Corps Local Protection Levees***	Corps-Supported Emergency Operations^	TOTAL
Colorado	0.0	0.0	0.0	0.0	0.0	1,609.8	0.0	0.0	1,609.8
Iowa	36,091.3	21,067.2	9,322.0	0.0	0.0	0.0	1,476.0	0.0	67,956.5
Missouri	9,456.2	0.0	1,703.1	0.0	0.0	0.0	0.0	0.0	11,159.3
Montana	162.3	0.0	0.0	8,330.5	2,534.5	0.0	0.0	550.0	11,577.3
Nebraska	43,622.8	18,367.2	1,460.8	0.0	2,960.1	0.0	14,002.5	0.0	80,413.4
N. Dakota	1,150.9	0.0	0.0	39.7	9,580.9	1,622.8	745.4	0.0	13,139.7
S. Dakota	0.0	0.0	0.0	625.2	199.7	0.0	6,366.9	800.0	7,991.8
Wyoming	0.0	0.0	0.0	421.3	9,372.2	0.0	1,007.9	1,500.0	12,301.4
TOTAL	90,483.5	39,434.4	12,485.9	9,416.7	24,647.4	3,232.6	23,598.7	2,850.0	206,149.2

* Additional local flood damage reduction benefits will be determined when data from certain USGS gages is available.
** Additional benefits for Pipestem Dam in North Dakota will be determined when the land use update is completed; additional local benefits for certain other Corps dam projects will be determined when the hydrologic data is available.
*** Additional local benefits for several Corps non-dam projects will be determined when the hydrologic data is available.
^ Additional benefits from Corps-supported emergency operations in Nebraska will be determined when the data is available.

TABLE 6

RECREATION VISITATION IN HOURS				
	FY92	**FY93**	**FY94**	**FY95**
Bowman-Haley	65,400	322,900	207,300	210,700
Cottonwood Springs	188,900	131,400	143,900	203,500
Cold Brook	474,200	98,100	114,800	70,100
Pipestem	317,200	288,400	302,000	285,000
Papillion Creek #11	1,662,800	732,500	534,000	464,800
Papillion Creek #16	628,300	308,200	234,900	215,500
Papillion Creek #18		575,100	645,500	749,300
Papillion Creek #20	1,073,100	534,500	520,800	609,400
Papillion Creek Total	3,364,200	2,150,300	1,935,200	2,039,000
Chatfield	4,267,100	4,944,600	5,676,400	4,654,600
Cherry Creek	6,682,400	11,462,200	7,741,300	8,551,700
Bear Creek	432,900	578,000	697,800	641,600
Salt Creek #2	81,600	88,200	61,600	91,600
Salt Creek #4	106,500	105,700	107,500	110,100
Salt Creek #8	106,300	99,700	83,100	100,800
Salt Creek #9	50,100	62,400	63,500	90,500
Salt Creek #10	103,700	38,600	36,700	44,000
Salt Creek #12	219,600	388,200	322,700	302,100
Salt Creek #13	75,800	22,700	20,900	26,900
Salt Creek #14	2,034,200	1,775,300	1,333,900	1,282,300
Salt Creek #17	3,880,100	1,623,800	1,584,500	1,360,900
Salt Creek #18	5,184,400	3,503,600	2,800,000	1,594,600
Salt Creek Total	11,842,300	7,708,200	6,414,400	5,003,800
TOTAL	**27,886,600**	**27,864,100**	**23,233,100**	**21,660,000**

VI. RESERVOIR OPERATION. Actual operations for the past year and proposed operations through calendar year 1996 are discussed briefly in the following subsections. Individual project operation summaries are contained in Appendix 1 for Corps of Engineers projects and Bureau of Reclamation projects. Table 7 summarizes the tributary reservoir flood control operation for 1995. A tabulation of the number of cases that the exclusive flood control zones in the 36 Omaha District tributary reservoirs have been filled to 25, 50, 75 and 100 percent is shown on Table 8.

TABLE 7
TRIBUTARY RESERVOIR FLOOD CONTROL OPERATION

COE	Flood Control Pool (Ft Msl)	Date in Flood Control Operation Pool	Daily Maximum Pool (Ft Msl)	Date of Maximum Pool	Maximum Daily Storage in FC Pool Acre Feet	Maximum % of FC Pool Occupied	Maximum Inflow CFS	Maximum Outflow CFS
Bear Creek	5558.0	15 May - 01 Jul	5587.2	17 Jun	5,135	18	795	612
Bowman-Haley	2754.8	17 Apr - 22 Jun	2758.8	14 May	11,306	11	2,096	1,256
Bull Hook	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cedar Canyon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chatfield	5432.0	15 Jun - 24 Jul	5446.4	04 Jul	25,511	12	3,390	3,350
Cherry Creek	5550.0	28 Jun - 31 Jul	5551.0	19 May	854	1.1	247	195
Cold Brook	3585.0	11 Nov - 31 Jul	3585.4	16 Jul	15	.2	3.0	3.0
Cottonwood	3936.0	n/a	3862.1	25 Jul	n/a	n/a	n/a	n/a
Kelly Road	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Papio No. 11	1121.0	01 Sep - 31 Jul	1122.4	27 May	739	5	114	42
Papio No. 16	1104.0	12 Mar - 27 Jun	1105.0	09 May	128	4	37	14
Papio No. 18	1110.0	01 Aug - 31 Jul	1112.0	09 May	547	7	128	55
Papio No. 20	1095.8	10 Apr - 03 Jul	1098.4	09 may	656	11	143	62
Pipestem	1442.4	01 Aug - 31 Jul	1479.5	22 May	69,991	52	2,938	616
Salt Ck No. 2	1335.0	17 Apr - 22 Jun	1338.4	08 May	591	15	285	105
Salt Ck No. 4	1307.4	11 Mar - 29 Jul	1311.7	08 May	1,458	21	424	126

COE	Flood Control Pool (Ft Msl)	Date in Flood Control Operation Pool	Daily Maximum Pool (Ft Msl)	Date of Maximum Pool	Maximum Daily Storage in FC Pool Acre Feet	Maximum % of FC Pool Occupied	Maximum Inflow CFS	Maximum Outflow CFS
Salt Ck No. 8	1287.8	01 Jan - 13 Jul	1291.6	09 May	1,321	20	356	117
Salt Ck No. 9	1271.1	20 Nov - 19 Jul	1274.8	07 May	843	18	337	85
Salt Ck No. 10	1244.9	14 Mar - 12 Jun	1249.5	09 May	1,146	20	279	93
Salt Ck No. 12	1232.9	01 Feb - 14 Jul	1236.6	08 May	953	12	339	121
Salt Ck No. 13	1341.0	04 Apr - 11 Jul	1343.0	08 May	548	10	265	137
Salt Ck No. 14	1244.3	01 Dec - 29 Jul	1246.0	08 May	1,292	6	353	147
Salt Ck No. 17	1242.4	01 Aug - 31 Jul	1244.9	07 May	344	6	176	86
Salt Ck No. 18	1284.0	01 Aug - 31 Jul	1286.6	08 May	5,821	8	1,096	371
Westerly Creek	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Spring Ck Dam	n/a	n/a	1623.0	18 Mar	n/a	n/a	n/a	n/a
Snake Ck Dam	1850.0	n/a	1847.1	09 May	n/a	n/a	n/a	n/a
USBR Reservoirs								
Boysen	4717.0	13 Jun - 28 Jul	4728.0	15 Jul	60,349	41.3	15,899	9,512
Canyon Ferry	3797.0	01 Jul - 29 Jul	3798.8	10 Jul	76,109	61	26,671	15,160
Clark Canyon	5537.7	06 Jun - 31 Jul	5553.7	15 Jul	40,616	51	2,563	1,538
Glendo	4635.0	21 May - 18 Jul	4641.7	14 Jun	94,906	19	7,925	7,540
Heart Butte	2064.5	21 Feb - 31 Jul	2067.4	14 May	10,284	7	2,003	1,145
Jamestown	1429.8	19 Mar - 23 Jul	1442.9	18 Apr	67,071	35	4,351	878

COE	Flood Control Pool (Ft Msl)	Date in Flood Control Operation Pool	Daily Maximum Pool (Ft Msl)	Date of Maximum Pool	Maximum Daily Storage in FC Pool Acre Feet	Maximum % of FC Pool Occupied	Maximum Inflow CFS	Maximum Outflow CFS
Keyhole	4099.3	n/a	4088.8	15 Jun	n/a	n/a	1,552	103
Pactola	4580.2	09 May - 24 Jun	4583.3	15 May	2,715	6	718	350
Shadehill	2271.9	08 May - 19 Jul	2275.8	15 May	159,115	9	4,542	2,911
Tiber	2976.0	10 Jun - 12 Jul	2995.3	25 Jun	41,585	10	15,495	4,431
Yellowtail	3640.0	13 May - 31 Jul	3646.3	17 Jul	92,685	33.4	18,073	14,415

TABLE 8

UTILIZATION OF EXCLUSIVE FLOOD STORAGE ZONE
OMAHA DISTRICT TRIBUTARY PROJECTS

Percent of Flood Control Storage

Year	Total of Tributary Projects	25% or More	50% or More	75% or More	100% or More
1967	26	3	2	2	0
1968	27	0	0	0	0
1969	27	1	0	0	0
1970	28	2	2	0	0
1971	28	2	1	0	0
1972	28	1	0	0	0
1973	28	6	2	1	0
1974	31	1	1	0	0
1975	32	6	2	1	1
1976	32	2	1	0	0
1977	32	0	0	0	0
1978	33	5	1	0	0
1979	33	1	0	0	0
1980	33	2	1	0	0
1981	33	2	1	1	0
1982	33	2	1	0	0
1983	34	5	1	1	0
1984	35	7	2	1	1
1985	35	0	0	0	0
1986	35	5	0	0	0

Year	Total of Tributary Projects	25% or More	50% or More	75% or More	100% or More
1987	35	3	0	0	0
1988	35	0	0	0	0
1989	35	0	0	0	0
1990	36	0	0	0	0
1991	36	2	1	0	0
1992	36	0	0	0	0
1993	36	12	0	0	0
1994	36	2	0	0	0
1995	36	6	3	0	0
TOTAL		**78**	**22**	**7**	**2**

a. Previous Years Operation (August 1, 1994 through July 31, 1995).

(1) **Corps of Engineers Lakes.** All Corps' tributary projects within the Omaha District were regulated in accordance with normal procedures during the period covered by this report. As shown on Table 7 Bear Creek, Bowman-Haley, Chatfield, Cherry Creek, Cold Brook, Papios #11, #16, #18, and #20, Pipestem, Salt Creeks #2, #4, #8, #9, #10, #12, #13, #14, #17, and #18, stored water in the flood storage zone or above their normal level at some time during the report period.

(a) Tri-Lakes Flood Control Operation. Following a relatively warm and dry fall and winter, the Colorado Rockies experienced heavy snowfalls and cooler weather in April, May and June. This weather pattern generated near record snowpack in much of the mountain basins including the South Platte River and tributaries. The cool weather into early spring did not allow significant melt of the snowpack. Peak May snowpack and runoff forecasts throughout many of the basins were 200 to 300 percent of normal. (See Table 9). Not only was the snowpack higher than normal in the South Platte River basin, but snow amounts were much above normal along most of the major tributaries of the front range downstream of Denver. Major flooding was expected in the Clear Creek, Big Thompson, St. Vrain, Cache la Poudre and other streams along the front range. The worst flooding was experienced along the St. Vrain and upper Clear Creek basins. Runoff from the heavy snowpack kept river levels very high for many weeks between May and July. May and June were also a time of localized heavy thunderstorms which caused some

flooding along the lower portions of several tributaries and added to the high flows already in the South Platte River. These storms made coordinated operation of the Tri-Lakes more difficult due to rapid rises along the tributaries and the South Platte River.

TABLE 9

South Platte Basin Snow Water Equivalent, Percent of Normal			
South Platte Basin	**April**	**May**	**June**
Sundance	112%	178%	n/a
Geneva Park	145%	356%	n/a
Antero	41%	200%	n/a
Antero Reservoir	110%	n/a	
Eleven Mile	--	>100	n/a
Weston	86%	143%	n/a
Horseshoe Mountain	81%	86%	n/a
Mosquito Creek	78%	97%	n/a
Como	77%	163%	n/a
Hoosier Pass (Snotel)	96%	111%	40%
Loveland Basin (Snotel)	108%	119%	34%
Clear Creek Basin			
Empire	86%	138%	
Berthoud Falls	85%	126%	
Berthoud Summit (Snotel)	96%	99%	

Of the Tri-Lakes projects, only Cherry Creek was not operated for flood control. Bear Creek reservoir set a new peak pool and Chatfield was forecasted to set a new record pool, however the snow did not melt as quickly as anticipated and the pool did not get as high as predicted. High releases were required from May through July.

During the report period, Chatfield Dam, in addition to Bear Creek Dam, were extensively operated for flood control operation. The downstream channel project on the South Platte appears to have worked quite well during the high flows. The only major problem is the lack of channel capacity downstream of Henderson. Many

farmers along the river were complaining of high water table in their adjacent fields due to the sustained high stages. They were also concerned with the extensive bank erosion and debris problems in the channel. These issues will be addressed in FY96-97 as part of the update and possible revision of the Water Control Manuals and Water Control Plans for each of the Tri-Lakes.

The following paragraphs summarize the operation of Bear Creek and Chatfield during the snowmelt runoff. Also, Figures 1 through 3 show the relation between Bear Creek and Chatfield pool levels, inflows, and outflows with stage and discharge at Henderson.

Snowmelt runoff regulation began about May 15 at Bear Creek and June 15 at Chatfield. Initial runoff forecasts from both the Natural Resources Conservation Service and the Corps, showed 200 to 300 percent of normal May - July runoff volume could be expected.

With the reservoirs on the rise, problems on the South Platte River downstream of Denver began to occur. On June 5th, a report came in about a private levee which had failed near the town of Platteville in Weld county. Hundreds of acres of farm ground were being flooded by the South Platte River because of the failure. Releases were cut back as much as possible, given the available information about runoff forecasts, to allow farmers the opportunity to repair the levee. Work on the levee was completed June 16, mostly with private resources.

Major flooding was predicted for the weekend of June 17, however the weather turned cooler and runoff was much less than expected. Cool weather lingered which allowed the snow to melt much more slowly, and as a result, less flooding was experienced. Most of the front range South Platte tributaries peaked by mid-June. During mid-June the Corps forecast at Chatfield showed pool levels were expected to hit 5470 feet msl around the first week in July. This would have been 23 feet higher than the record pool of 5447.58 feet msl. The actual peak pool was 5546.40 and occurred on July 4th.

Bear Creek Reservoir was operated in coordination with Chatfield to minimize downstream flood impacts. Since Bear Creek is much smaller than Chatfield, the reservoir elevation changes much more quickly, as can be seen on Figure 2. Bear Creek Reservoir releases were also cut back after the levee failure, and if possible when flooding occurred on the South Platte and Bear Creek near Sheridan. The new record pool at Bear Creek Reservoir was 5587.17 and occurred on June 17th.

Chatfield releases were cut back at least 5 times because of downstream flooding. Bear Creek releases were cut back several times. Response to every event was not possible however due to short lead times and flash floods from local storms. Several times releases were cut based on a forecast of extensive rain to provide extra

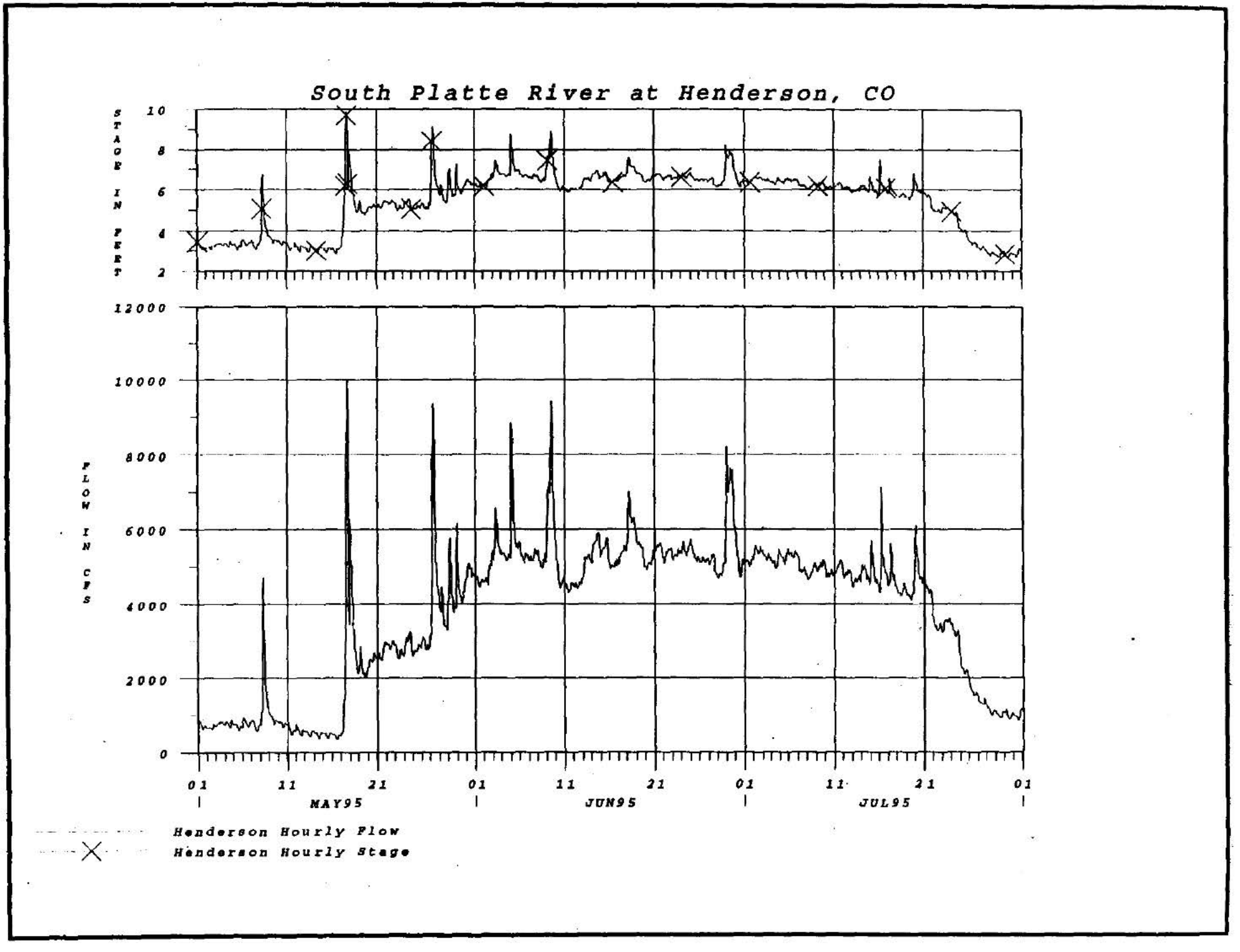
space within the channel at Henderson and downstream. The downstream target was at Henderson and was approximately 5000 cfs. Channel capacity at Henderson is about 10,000 but it is much less downstream. Therefore, there were additional problems downstream of Henderson.

Several complaints were received concerning the sustained high flows in the South Platte River created by the operation of Chatfield and Bear Creek (but primarily from Chatfield). Various downstream interests felt it was not proper management of the available storage to not fill the reservoir before releases were made. A visit was made to the area along the South Platte near Fort Lupton at the request of several local farmers. There was streambank erosion and seepage into the adjacent fields due to the high river level. Several alternatives will be looked at in the Water Control Manual Revision for the Tri-Lakes to determine if the reservoirs can be operated differently. (See Section VII for additional regulation problems).

(b) Bear Creek Reservoir, Colorado Normal Operations. During the report period, the district renewed the two temporary one-year municipal and industrial water supply storage contracts for a total of 74 acre-feet under Section 6 of the Flood Control Act of 1944 (Public Law 534, 78th Congress), pending development of a long-term contract under the Water Supply Act of 1958, as amended. A revised Memorandum of Understanding (MOU) between the Corps of Engineers and the State of Colorado was signed on June 20, 1988, superseding the previous MOU dated May 11, 1977. Under the revised MOU, the State Engineer or his representative will determine the storage and releases necessary to satisfy downstream water rights requirements when the pool level is below elevation 5559.0 ft MSL. This target elevation encroaches one foot into the flood storage zone and was selected to allow flexibility in targeting authorized pool levels. During the report period, continuous gated regulation was made to release Lakewoods stored water. In January 1992, the Denver Regional Council of Governments (DRCOG) requested the Corps of Engineers' participation in a demonstration project at Bear Creek Reservoir using hypolimnetic withdrawals throughout the year. These releases were continued into early 1995 and then stopped. Results from this study have not been finalized. There have not been any requests to continue the low level releases.

Prior to April 1995, the low level gate was opened to provide release of both inflow and stored water.

(c) Chatfield Reservoir, Colorado Normal Operations. Gated releases varied from a maximum daily average of 3350 cfs on July 7, 1995, to 0 cfs releases in January and February. A total of 15,991 acre-feet was delivered via the canals during the report period compared with 19,745 acre-feet during the last report period. The pool was in the flood control storage zone through much of the report period in 1995. Bottom of flood control pool is elevation 5432.0. The maximum pool elevation during this period was 5446.40 on July 4, 1995.


South Platte River at Henderson, CO
STAGE IN FEET
10
8
6
4
2
FLOW IN CFS
12000
10000
8000
6000
4000
2000
0
01
11
21
01
11
21
01
11
21
01
MAY95
JUN95
JUL95
Henderson Hourly Flow
Henderson Hourly Stage

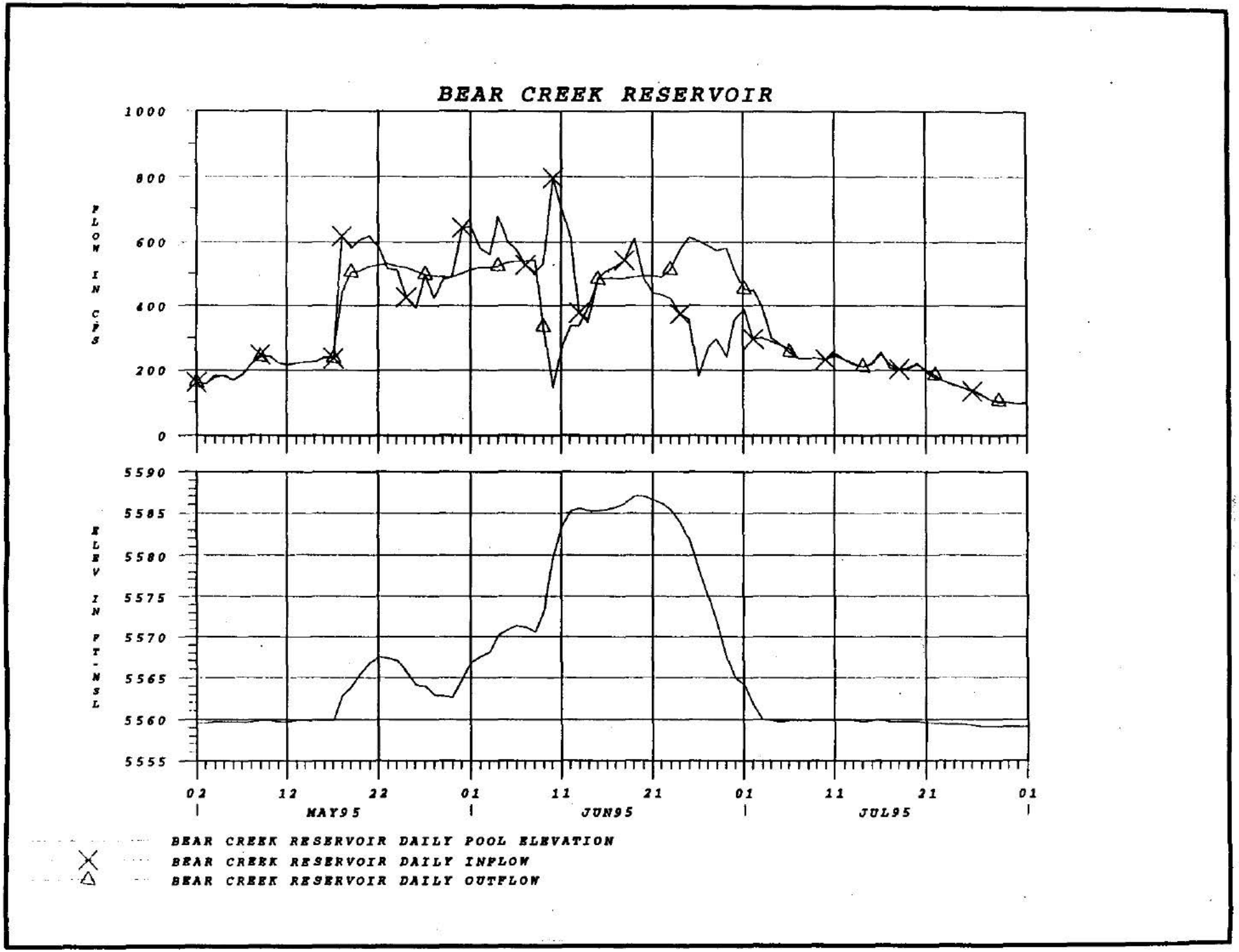
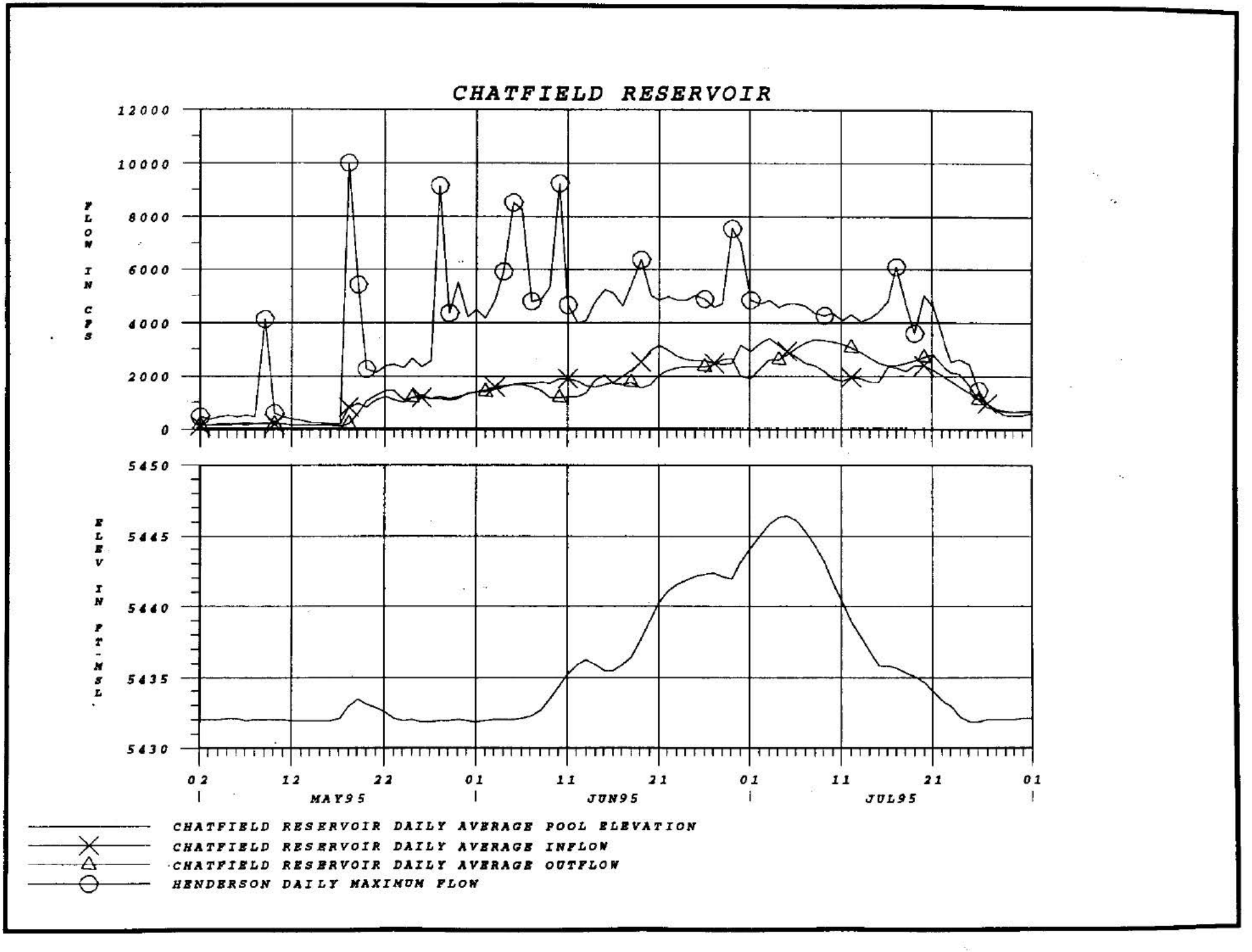

BEAR CREEK RESERVOIR
1000
800
600
400
200
0
FLOW IN CFS
5590
5585
5580
5575
5570
5565
5560
5555
ELEV IN FT-MSL
02
12
22
01
11
21
01
11
21
01
MAY95
JUN95
JUL95
BEAR CREEK RESERVOIR DAILY POOL ELEVATION
BEAR CREEK RESERVOIR DAILY INFLOW
BEAR CREEK RESERVOIR DAILY OUTFLOW

FIGURE 7


CHATFIELD RESERVOIR
FLOW IN CFS
12000
10000
8000
6000
4000
2000
0
ELEV IN FT-MSL
5450
5445
5440
5435
5430
02
12
22
01
11
21
01
11
21
01
MAY95
JUN95
JUL95
CHATFIELD RESERVOIR DAILY AVERAGE POOL ELEVATION
CHATFIELD RESERVOIR DAILY AVERAGE INFLOW
CHATFIELD RESERVOIR DAILY AVERAGE OUTFLOW
HENDERSON DAILY MAXIMUM FLOW

(d) Cherry Creek Reservoir, Colorado Normal Operations. On April 1, 1988, the State of Colorado, through the State Engineer, implemented strict administration of water rights within the Cherry Creek basin. When a senior river call is in effect, the Cherry Creek Reservoir is required to pass inflow through the project. Releases from the project were coordinated by the Water Control Section to comply with downstream river calls as determined by the Colorado State Engineers office. A total of 23 release orders were made during the report period. The releases were made to meet downstream water needs, to maintain the pool level, and for a sediment flushing exercise. Releases varied from 70 cfs to 5 cfs for water control and water rights and up to 1200 cfs during the flushing exercise. Gate changes were made between August 1, 1994 and July 31, 1995. The sediment flushing releases were made May 10 & 11, 1995 to remove sediments inside of the intake and conduit. This exercise will be completed annually. The State of Colorado Division of Parks and Recreation has been purchasing water from various sources and using this to exchange for Cherry Creek inflow. Because of these exchanges, and the over abundance of water elsewhere in the South Platte basin, few releases were required for Cherry Creek water rights.

(e) Papillion Creek Basin, Nebraska. Minor low-level releases were made at Papillion Creek Reservoir #16 to lower pool level to facilitate inspection of the outlet conduit.

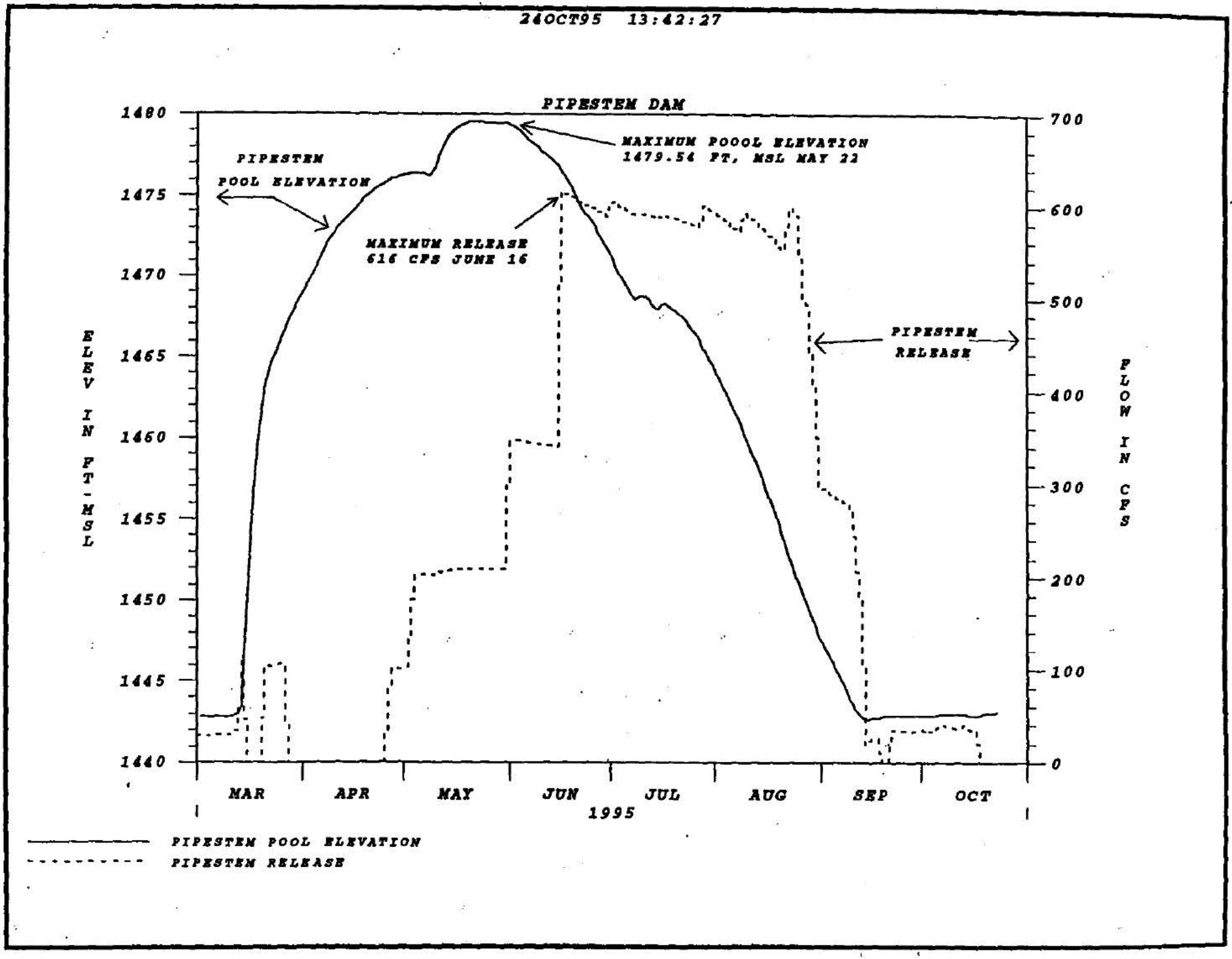
(f) Salt Creek Basin, Nebraska. Minor releases were made from Salt Creek Reservoir #10, Yankee Hill, to lower the pool to facilitate inspection of the outlet conduit because of seepage from the embankment just upstream of the outfall. It was found that one of the joints in the conduit had separated slightly which allowed water to seep out at the joint. Several corrections were investigated. Caulk was applied as a short term solution to the problem. It has still not been decided what to do for a long term fix. A 6 cfs release was made from Salt Creek Dam #18 from July 27th through September 6th for downstream water rights.

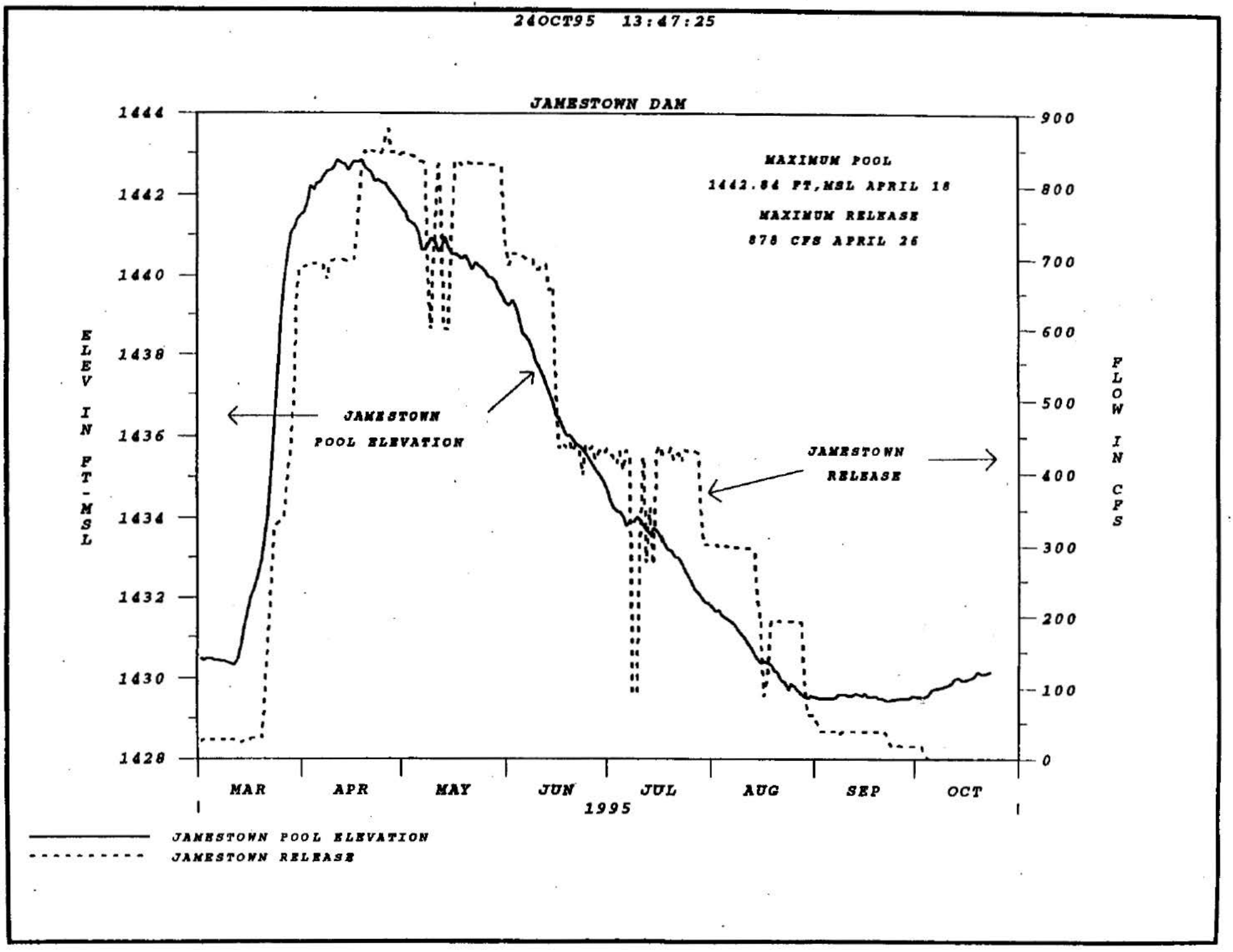
(g) Bowman-Haley, North Dakota. The pool at Bowman-Haley Reservoir had been drawn down two feet the previous fall of 1994. Following an early warming period the first of February, the low level gate was opened on February 9th discharging 20 cfs. It was agreed to hold the pool level two feet down to alleviate shoreline erosion. On March 15th the mid-level gate was opened discharging 70 cfs exclusive of flow over the morning glory. The pool remained at or above the morning glory until late June. In early July the low level gates were closed.

(h) Pipestem, North Dakota. The 1995 regulation began with a letter to the City of Jamestown on February 14, 1995 warning of the likelihood of considerable runoff this spring. Soil moisture and streamflow in the James River and Pipestem Creek basins were above normal and any snowmelt or spring runoff would result in high inflow into the projects. At that time we felt sure that we would be releasing 450 cfs and possibly as much as 750 cfs.

Unusual high spring snowmelt runoff into Pipestem and Jamestown Reservoirs resulted in inflows more than four times greater than normal. A snowpack containing 3 to 4 inches of water equivalent accumulated over the winter months in the drainage basin upstream from Pipestem and Jamestown Reservoirs. With frost depths up to 4 feet deep and depression storage areas filled from record runoff last fall, nearly all of the water accumulated in the snowpack resulted in runoff during a rapid warmup which began in mid-March.

Inflow into Pipestem Dam crested on March 17th and Jamestown Dam seven days later on March 24th. Releases were limited to 450 cfs until the City of Jamestown completed the placement of channel blocks in the oxbow area. At the end of March releases were increased to 750 cfs.


24OCT95 13:42:27
PIPESTEM DAM
MAXIMUM POOOL ELEVATION
1479.54 FT, MSL MAY 22
PIPESTEM
POOL ELEVATION
MAXIMUM RELEASE
616 CFS JUNE 16
PIPESTEM
RELEASE
ELEV IN FT-MSL
FLOW IN CFS
1480
1475
1470
1465
1460
1455
1450
1445
1440
700
600
500
400
300
200
100
0
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
1995
PIPESTEM POOL ELEVATION
PIPESTEM RELEASE


24OCT95 13:47:25
JAMESTOWN DAM
MAXIMUM POOL
1442.84 FT,MSL APRIL 18
MAXIMUM RELEASE
878 CFS APRIL 26
JAMESTOWN
POOL ELEVATION
JAMESTOWN
RELEASE
ELEV IN FT-MSL
FLOW IN CFS
1444
1442
1440
1438
1436
1434
1432
1430
1428
900
800
700
600
500
400
300
200
100
0
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
1995
JAMESTOWN POOL ELEVATION
JAMESTOWN RELEASE

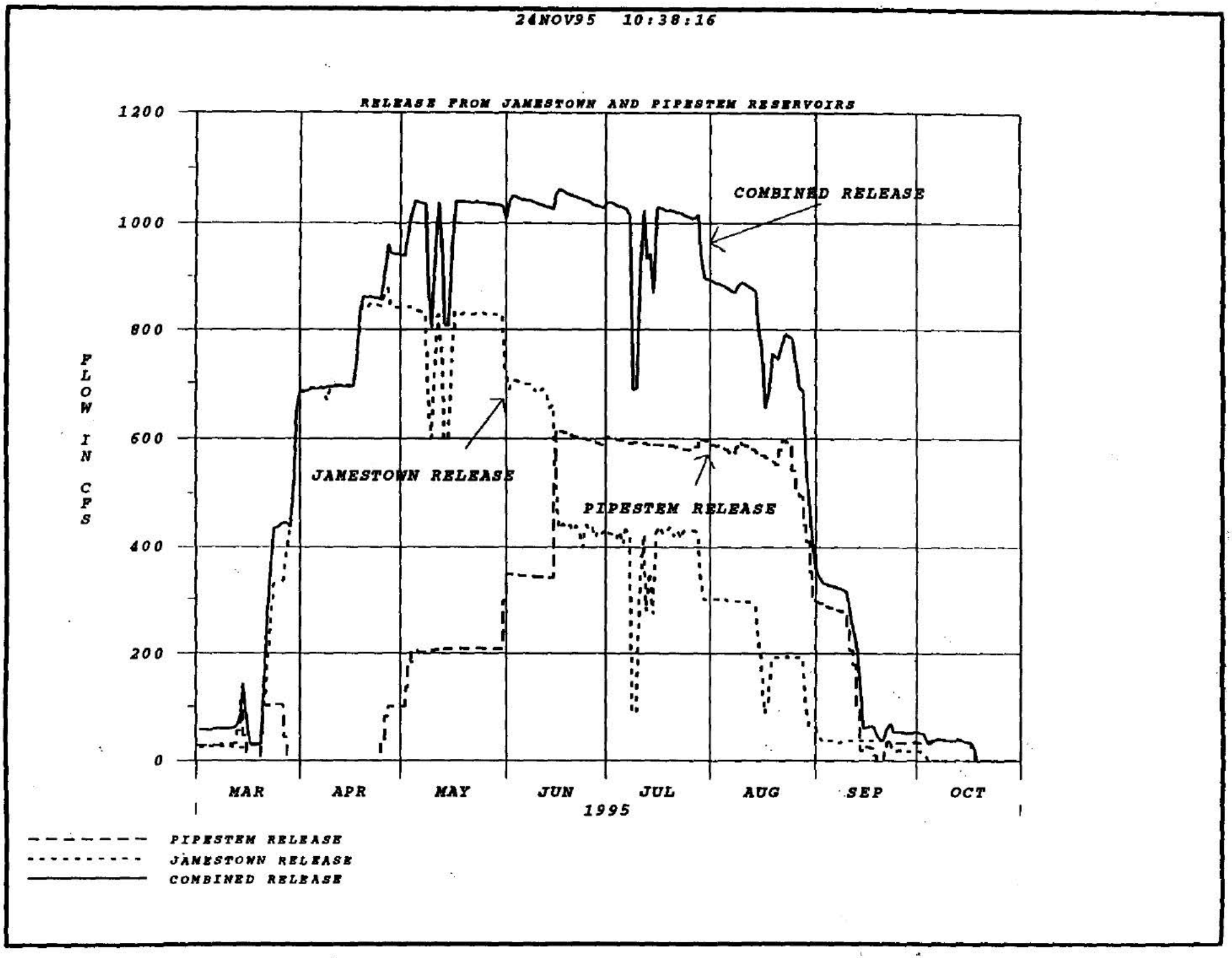

24NOV95 10:38:16
RELEASE FROM JAMESTOWN AND PIPESTEM RESERVOIRS
1200
1000
800
600
400
200
0
FLOW IN CFS
COMBINED RELEASE
JAMESTOWN RELEASE
PIPESTEM RELEASE
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
1995
PIPESTEM RELEASE
JAMESTOWN RELEASE
COMBINED RELEASE

FIGURE 6

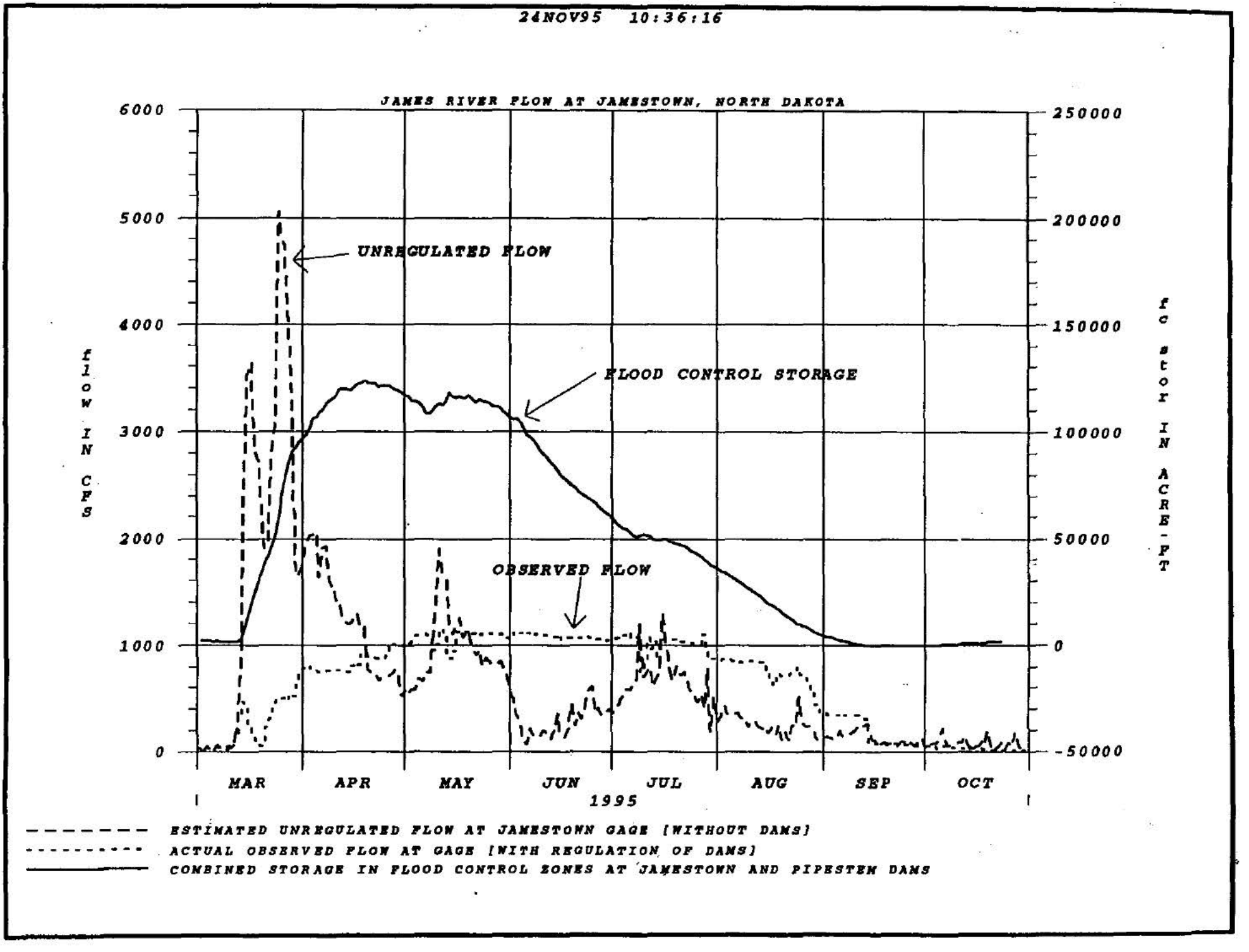

24NOV95 10:36:16
JAMES RIVER FLOW AT JAMESTOWN, NORTH DAKOTA
6000
5000
4000
3000
2000
1000
0
flow in CFS
250000
200000
150000
100000
50000
0
-50000
fc stor IN ACRE-FT
UNREGULATED FLOW
FLOOD CONTROL STORAGE
OBSERVED FLOW
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
1995
ESTIMATED UNREGULATED FLOW AT JAMESTOWN GAGE [WITHOUT DAMS]
ACTUAL OBSERVED FLOW AT GAGE [WITH REGULATION OF DAMS]
COMBINED STORAGE IN FLOOD CONTROL ZONES AT JAMESTOWN AND PIPESTEM DAMS

FIGURE 7

On April 12 a deviation from the 1975 Field Working Agreement was granted and releases were increased to 900 cfs, combined discharge from both dams. This was granted due to the increasing risk of being forced to make an 1800 cfs release at Jamestown Dam and the fact that there was sufficient channel capacity in the city of Jamestown. In addition, Bureau of Reclamation officials were becoming alarmed at seepage below Jamestown Dam.

On April 21, a second deviation was granted and releases were increased to 1050 cfs, combined discharge. This was made in response to increasing concerns at seepage below Jamestown Dam. This record release resulted in basement seepage and flooding of backyards in residential areas.

The operation of Jamestown and Pipestem Dams during the 1995 year is summarized in Figures 4 through 7.

(2) Bureau of Reclamation Dams. Reservoir operations at the 11 Bureau of Reclamation projects in the Omaha District were carried out in accordance with normal regulation procedures during the period covered by this report. Ten of the eleven Section 7 projects stored water in the flood control zone.

(a) Boysen Dam, Wyoming. The general objectives of the water control plan for Boysen Reservoir is for the local reduction of flow in the reaches between Boysen Dam and Yellowtail Dam/Bighorn Reservoir although coordinated regulation with Yellowtail to affect maximum reductions in downstream areas will still be a factor.

Three federal agencies, the Corps, Bureau of Reclamation, and the Natural Resources Conservation Service (NRCS) are responsible for monthly providing independent April to July inflow forecasts for Boysen. The Corps calculates their forecasts based on September and October precipitation (antecedent conditions), observed January to June snowpack and actual and anticipated April to June precipitation. Table 10 displays the agencies' 1995 forecasts.

Table 10
Forecasted % of Normal April - July 1995 Boysen Inflow

Agency	Feb 1	Mar 1	Apr 1	May 1	Jun 1
U.S. Army Corps of Engineers	92	75	92	127	166
Bureau of Reclamation	85	82	86	97	158
Natural Resources Conservation District	111	97	105	129	180

As stated in the Field Working Agreement (dated May 5, 1967) and Part 208 - Flood Control Regulation of the Federal Register (dated April 12, 1967), the Corps will assume regulation of that portion of the joint use zone as determined by Figures 1 and 2 of GM 16-3/1, Flood Control Storage Reservoir Diagram of the Boysen Water Control Manual. As per the figures, the Corps assumed regulation control of the entire joint use pool (4717.0 feet to 4725.0 feet, msl). A letter was sent from the Corps to the Bureau, dated June 14, 1995, referencing that the Corps would assume regulation control of the joint use zone.

Several considerations are given in determining releases from Boysen Dam: 1) discharges from Bull Lake Dam upstream of Boysen Reservoir, 2) safe maximum discharge capacity of 10,600 cfs, 3) downstream channel capacity of Kane, Wyoming of approximately 15,000 cfs, and 4) inflow and discharge conditions of downstream Bighorn Lake/Yellowtail Dam.

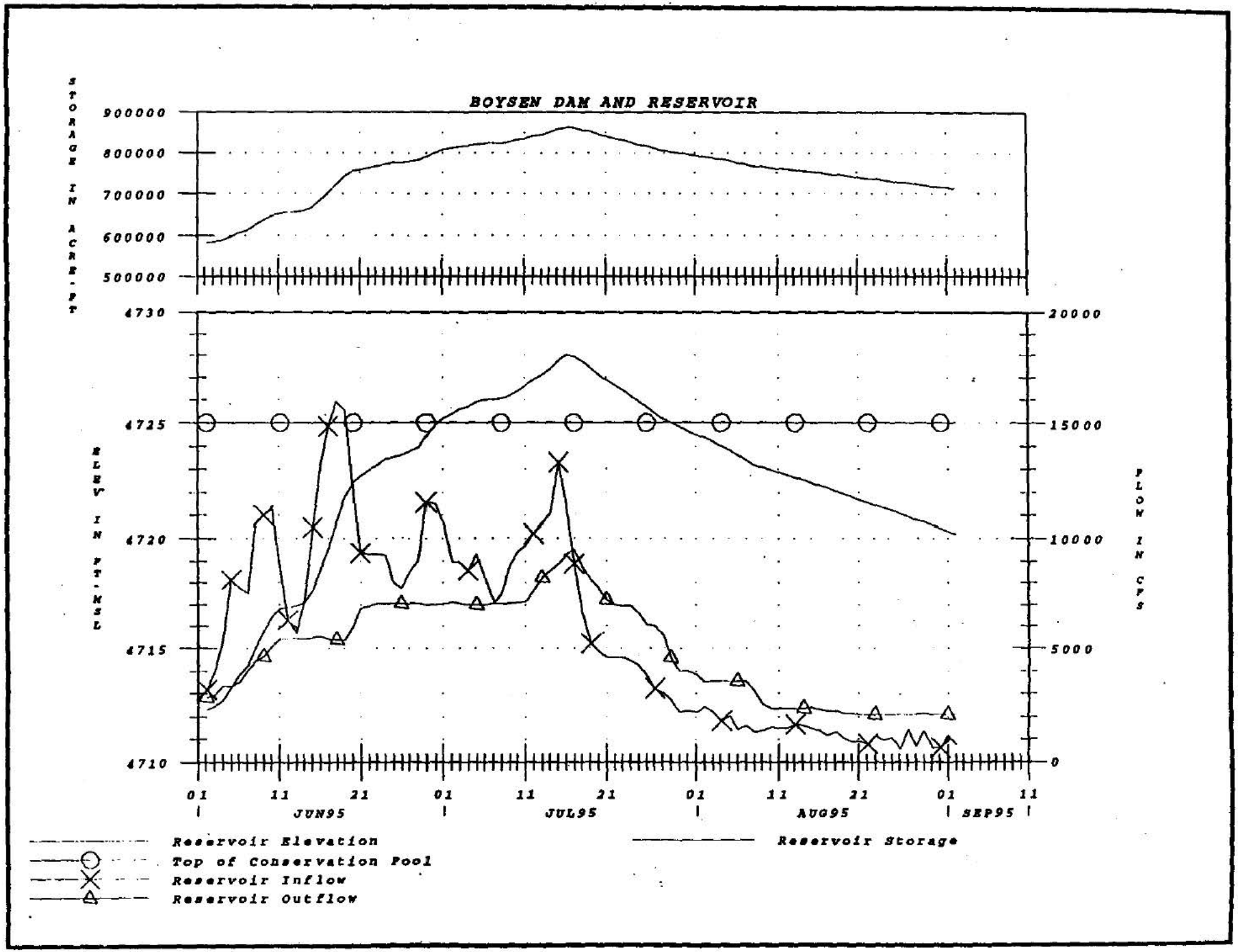

BOYSEN DAM AND RESERVOIR
STORAGE IN ACRE-FT
900000
800000
700000
600000
500000
ELEV IN FT-MSL
4730
4725
4720
4715
4710
FLOW IN CFS
20000
15000
10000
5000
0
01
11
21
01
11
21
01
11
21
01
11
JUN95
JUL95
AUG95
SEP95
Reservoir Elevation
Top of Conservation Pool
Reservoir Inflow
Reservoir Outflow
Reservoir Storage

FIGURE 8

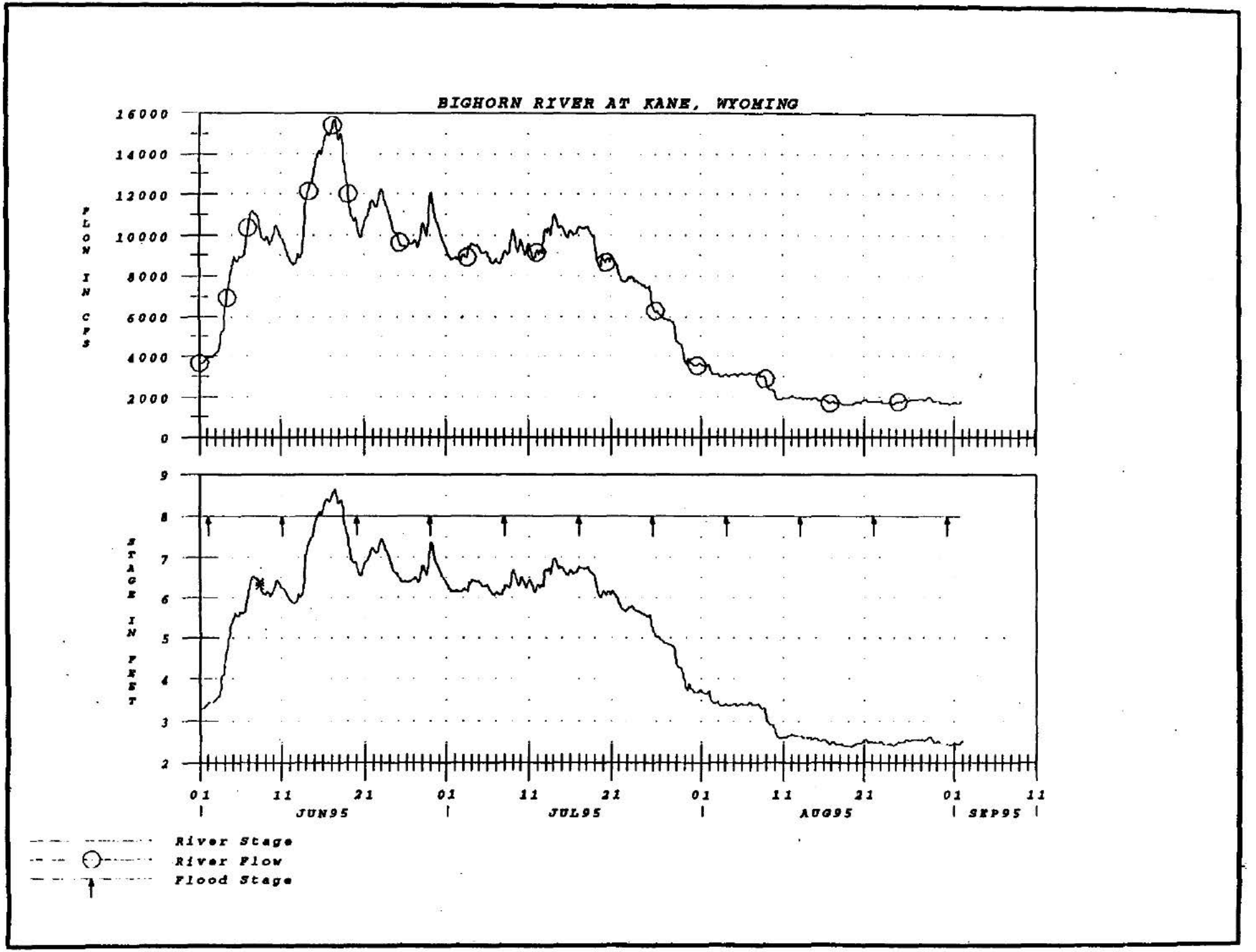

BIGHORN RIVER AT KANE, WYOMING
FLOW IN CFS
16000
14000
12000
10000
8000
6000
4000
2000
0
STAGE IN FEET
9
8
7
6
5
4
3
2
01
11
21
01
11
21
01
11
21
01
11
JUN95
JUL95
AUG95
SEP95
River Stage
River Flow
Flood Stage

FIGURE 9

Boysen Reservoir entered the joint use pool (JUP) (elevation 4717.0 feet, msl) June 13th. The discharge was 5300 cfs, full power plant capacity. At 1800 hours, MDT, June 19; 1995, the discharge was increased to 7000 cfs. That same day the Bureau issued a press release advising the public of increased releases and higher river levels. Figure 8 displays Boysen Reservoir inflows, outflows, elevation, and storage. Figure 9 displays the discharges and gage height at the downstream station at Kane, Wyoming.

Only July 12, 1995 discharges were increased from 7000 cfs to 8000 cfs due to anticipated increased inflows from a warming trend.

The crest of the outlet radial gates of Boysen Dam when closed are at elevation 4725.0, top of the joint use pool. As the gates are opened to make releases, the crest of the gates rise correspondingly. The rate of increase in pool level caused some concern regarding wind-wave action and possible overtopping of the gates. On July 14 and 15 the discharges were increased from 8000 cfs to 9500 cfs to 1) increase the gate crest and 2) slow the rate of increasing pool elevation.

Inflows peaked July 17, 1995 and fell below discharges. The releases were then lowered over a 5-day period to 7000 cfs. Downstream irrigation demands allowed for Boysen releases to stay ahead of inflows resulting in a steady decline of the pool level.

Boysen Reservoir exited the flood control pool (FCP) July 28, 1995.

Maximum pool elevation = 4727.99 feet msl, 41.3% of FCP occupied,
July 15, 1995
Maximum daily inflow = 13,260 cfs, July 14, 1995
Maximum daily outflow = 9,512 cfs, July 16, 1995

The flow regulation by Boysen Dam significantly reduced discharges downstream of the project. Table 11 shows a comparison of natural versus regulated flows.

Table 11
Bighorn River Natural and Regulated Floods

	Natural Peak Flow (cfs)	Regulated Peak Flow (cfs)
Bighorn River below Boysen Dam	15,800	9,450
Bighorn River at Kane, WY	23,600	15,200

(b) Canyon Ferry Dam, Montana. Late snowfall and cool temperatures resulted in continued accumulation of snowpack well into May. The much above average snowpack resulted in very high inflow forecasts for May and June. Releases were increased to 15,000 cfs in June. However, as inflows dropped in late June, discharges were reduced to as low as 6,000 cfs in order to fill the conservation pool. The inflow remained at a high enough level to force releases to be increased back to 15,000 cfs level. Flood water was stored in 61 percent of the flood control pool.

(c) Clark Canyon Dam, Montana. Clark Canyon Reservoir was operated for flood control from Jun 6, 1995 to Aug 22, 1995. During this time the reservoir was operated as close as possible to the flood control regulation criteria contained in the 1976 "Report on Reservoir Regulations for Flood Control". The manual specifies "Project releases will be made as necessary to prevent the discharge from exceeding 1,500 cfs at the Barretts gage".

During the flood control operation, the releases began in the range of 500 cfs and finished in the range of 1500 cfs. The flow in the Beaverhead through Dillon was monitored continuously by Jay Chamberlain and Larry Lakner. The big problem in determining how much to release was guessing how much flow was in the Grasshopper and Blacktail Creeks. Grasshopper comes into the Beaverhead above the Barretts gage and Blacktail flows through Dillon, coming in below the Dillon gage.

The maximum non-impacting discharge through Dillon is estimated at 950 cfs and when discharges approach 1300 cfs as many as 200 - 300 homes are threatened. The estimated maximum discharge at the Dillon gage was 1340 cfs on Jul 13. At this discharge, there was fear that the Beaverhead would spill over into Selway Slough and impact a large neighborhood. Therefore releases out of Clark Canyon were reduced.

The difficulty in trying to regulate Clark Canyon for flows in Dillon is two fold; (1) the long travel time from the dam to Dillon - 15 hours, and (2) the lack of monitoring and forecasting on the Blacktail and Grasshopper. Plans are in the works for installing DCP's, possibly on the two creeks and on the Beaverhead at Barretts and at Dillon.

(d) Glendo Dam, Wyoming. The general objectives of the water control plan for Glendo Dam and Reservoir calls for the District Engineer (Corps) to make discharges from Glendo Dam "considered necessary based on known hydrologic conditions at the time with the objective of prevention of reduction of flood damages along the North Platte River in Wyoming and Nebraska from Glendo Dam to Lake McConaughy (Kingsley Dam)."

Several considerations are given in determining releases from Glendo Dam: 1) incremental inflows downstream of Glendo Dam and upstream of the re-regulating Guernsey Dam, which has a total capacity of only 30,000 acre-feet; 2) downstream irrigation canal diversions from the North Platte; 3) releases from Grayrocks Dam on the Laramie River; and 4) incremental inflows between Guernsey Dam and Scottsbluff, Nebraska, considered the damage "hot spot" of all the populated areas situated on the North Platte River between Glendo Dam and Kingsley Dam.

Glendo Reservoir entered the flood control pool May 21, 1995 at 1400 hours MDT. The discharge was 0 cfs and flow at the Orin, Wyoming gage indicated an inflow of approximately 4700 cfs. The following releases were made:

500 cfs at 1600 hours, MDT, May 22
750 cfs at 2400 hours, MDT, May 22
1000 cfs at 0800 hours, MDT, May 23
2000 cfs at 0800 hours, MDT, May 24
3000 cfs at 0800 hours, MDT, May 25
3400 cfs at 0800 hours, MDT, May 26

Reclamation issued a press release May 22 outlining the aforementioned releases and advised residents and recreationists to remain alert to changing river and reservoir conditions.

Pool elevation at 2400 of the 25th of may was 4636.99 feet, 5.5% of the flood control storage occupied.

Inflows into Glendo Reservoir had been steadily decreasing to approximately 4000 cfs the morning of the 26th. However, unusually warm weather caused snowmelt runoff, increasing flows to the North Platte River. The peak of 8300 cfs occurred around midnight of the 28th.

May 30 status:
- Glendo discharge = 3400 cfs
- Guernsey discharge = 5500 cfs
- Interstate canal diversion = 900 cfs
- Ft. Laramie canal diversion = 650 cfs
- N Platte R passing Whalen Diversion Dam = 3300 cfs (est)

The increased inflows prompted an additional release of 500 cfs for a total release of 3900 cfs at 0900 hours MDT, May 31. Pool elevation at 2400 hours MDT, May 30 was 4638.61, 10% of flood control storage.

Starting June 7, the downstream irrigation canals, interstate and Ft. Laramie, began decreasing their diversions from the North Platte River. Consequently, discharges from Glendo were decreased from 3900 cfs to 3400 cfs. Large rains in the upper Laramie River basin caused inflows into Grayrocks Reservoir (see plate). Basin Power Electric, which operates Grayrocks, initiated increasing releases from 950 cfs to 3000 cfs.

In order to minimize flooding downstream of the mouth of the Laramie River, discharges at Glendo Dam were reduced from 3400 cfs to 1400 cfs.

From June 8th to the 13th, while Glendo releases remained at 1400 cfs, average inflow was 4520 cfs. Glendo reservoir elevation on June 13th was 4641.62 feet above msl, 19% of flood control pool occupied. Inflows to Grayrocks began to gradually recede allowing increased discharges from Glendo. During the time, the discharge observed at the state line gage peaked at approximately 5700 cfs. The peak discharge at the "hot spot" of Scottsbluff, a half day's travel time downstream of the state line gage, was estimated at 6000 cfs. No damages were observed at Scottsbluff. Discharges from Glendo from June 13-16 were increased from 1400 cfs to 3200 cfs, full power plant capacity. Figures 10 displays the Glendo Reservoir inflow, outflow, elevation and storage. Figure 11 displays the discharge and gage height at the downstream station North Platte River at State Line.

The downstream irrigation users have an agreement with Reclamation in place that allows for an annual Guernsey Dam "silt run". The silt run consists of emptying the 30,000 acre-feet storage in Guernsey Reservoir. High discharges are then released from Glendo and Guernsey to convey the sediment in Guernsey Reservoir downstream to line the downstream irrigation channels with sediment. This results in a more efficient irrigation channel. In order to empty Guernsey Reservoir, reduced discharges from Glendo were required:

- June 22 at 0800 MDT, reduce from 3200 cfs to 2500 cfs
- June 27 at 0800 MDT, reduce from 2500 cfs to 2000 cfs
- June 30 at 0800 MDT, increase from 2000 cfs to 2500 cfs
- July 3 at 0800 MDT, reduce from 2500 cfs to 2000 cfs
- July 4 at 0800 MDT, reduce from 2000 cfs to 1700 cfs
- July 7 at 0800 MDT, increase from 1700 cfs to 2000 cfs

Downstream irrigation demands allowed Glendo releases to stay ahead of inflows resulting in a steady decline of the pool level.

Glendo reservoir exited the flood control pool July 18th.

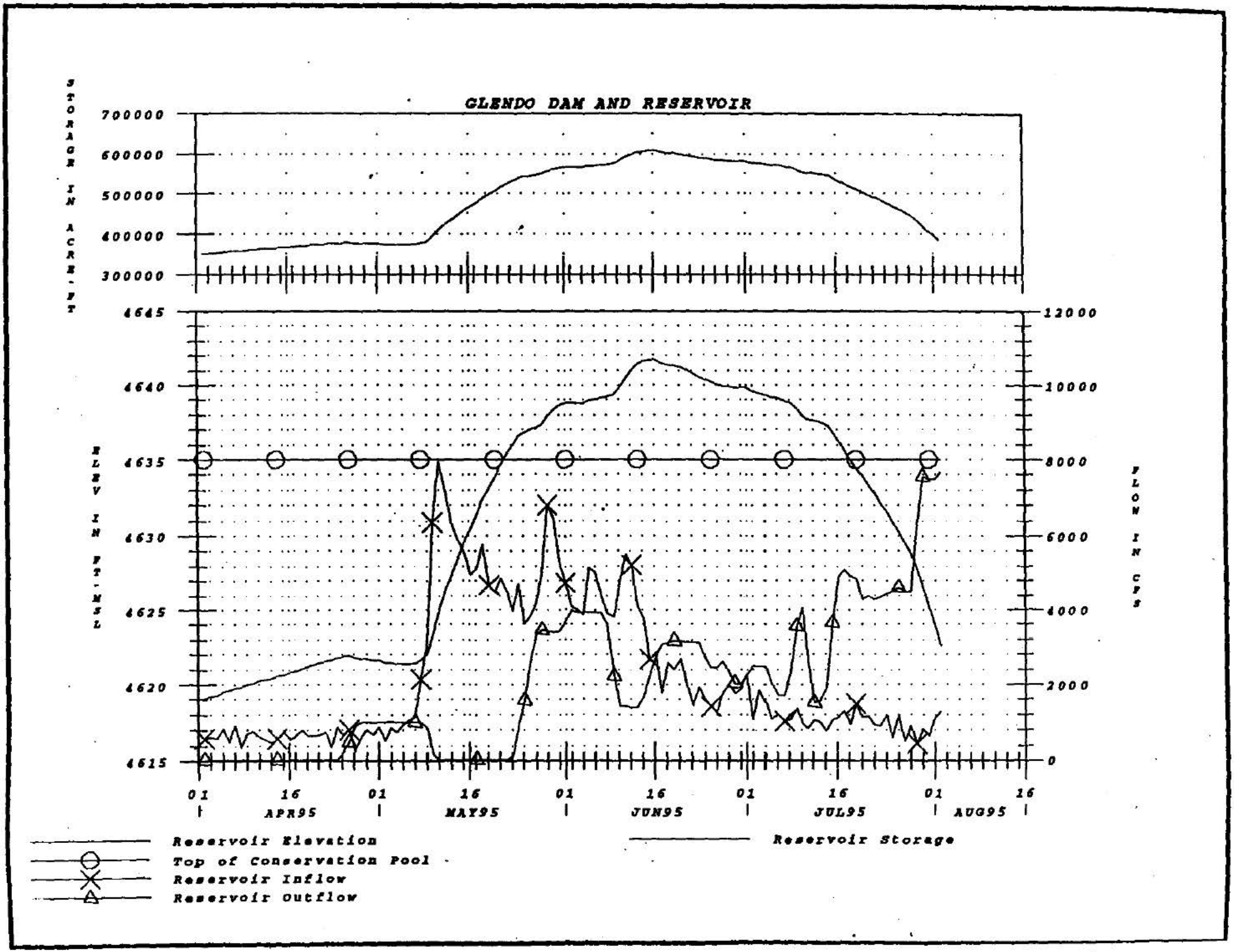

GLENDO DAM AND RESERVOIR
STORAGE IN ACRE-FT
700000
600000
500000
400000
300000
ELEV IN FT-MSL
4645
4640
4635
4630
4625
4620
4615
FLOW IN CFS
12000
10000
8000
6000
4000
2000
0
01
16
01
16
01
16
01
16
01
16
APR95
MAY95
JUN95
JUL95
AUG95
Reservoir Elevation
Top of Conservation Pool
Reservoir Inflow
Reservoir Outflow
Reservoir Storage

FIGURE 10

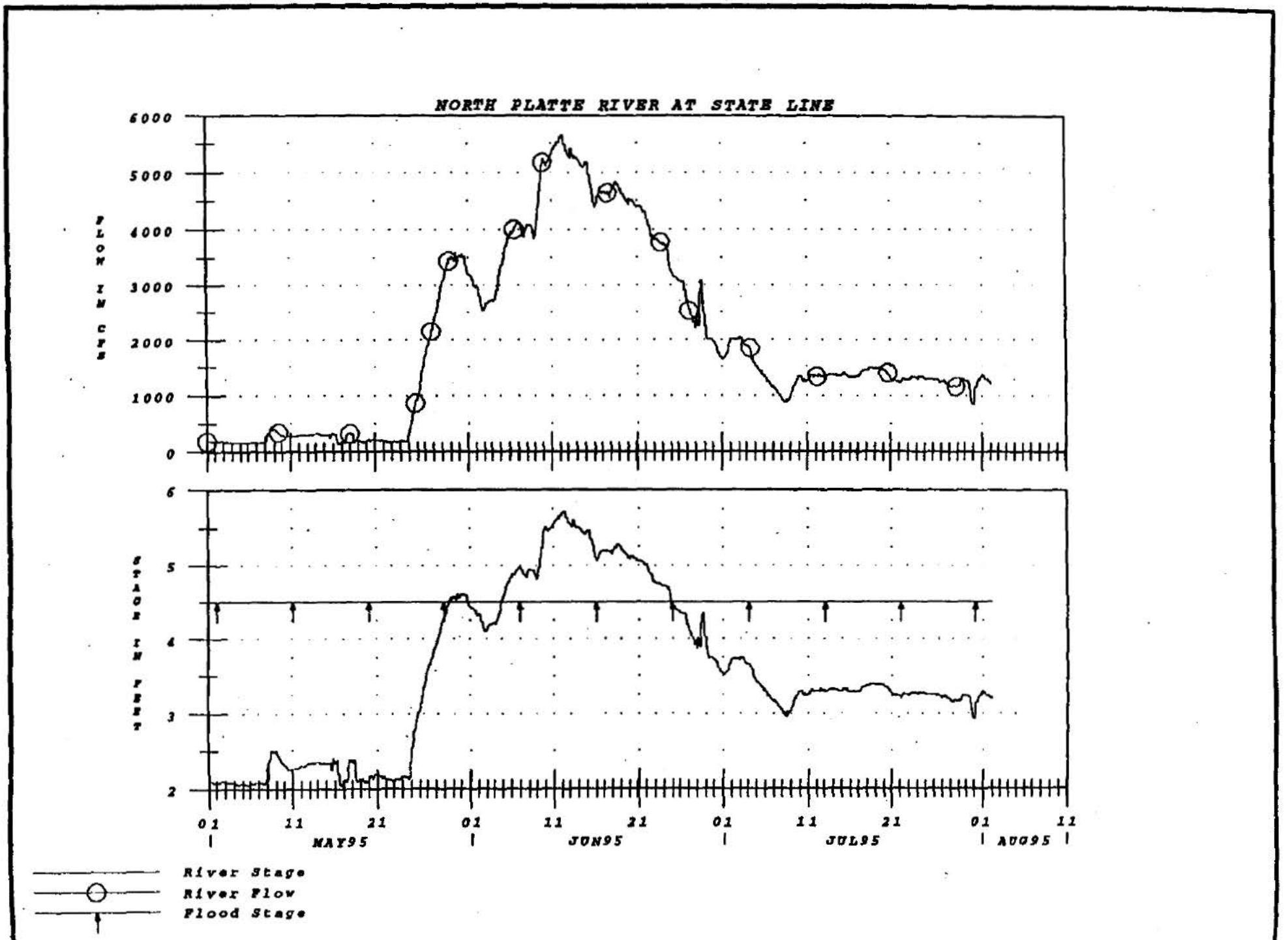

NORTH PLATTE RIVER AT STATE LINE
FLOW IN CFS
6000
5000
4000
3000
2000
1000
0
STAGE IN FEET
6
5
4
3
2
01
11
21
01
11
21
01
11
21
01
11
MAY95
JUN95
JUL95
AUG95
River Stage
River Flow
Flood Stage

FIGURE 11

Maximum pool = 4641.62, 19.5% FCP occupied, June 14
Maximum daily inflow = 7925 cfs, June 10th
Maximum outflow = 5100 cfs, July 16th

The flow regulation provided by Glendo Dam significantly reduced discharges downstream of the Project. Table 12 shows a comparison of natural versus regulation flows.

Table 12
North Platte River Natural and Regulated Flows

	Natural Peak Flow (cfs)	Regulated Peak Flow (cfs)
North Platte River at State Line	19,800	5,660
North Platte River at Lewellen, NE	21,400	7,240

(e) Jamestown Dam, North Dakota. As this project is operated in tandem with Pipestem Dam, refer to Section VI.a.(1)(h), Pipestem, North Dakota, for a discussion of the operation of Jamestown Dam.

(f) Pactola Dam, South Dakota. Heavy rains beginning on May 6th and ending on May 9th resulted in the second highest inflow of record into Pactola Reservoir. A total 4-day rainfall of 3.87 inches was recorded at the dam. Inflow crested at 718 cfs on May 9th.

Releases were increased to 350 cfs on May 15. On May 14 the pool level exceeded elevation 4583.0. According to Table A of the Standing Instructions to Dam Tender, the required release was 400 cfs. However, releases greater than 350 cfs would result in minor problems in the canyon reach of Rapid Creek and would also leave less space in the channel for incremental runoff. The maximum non-damaging channel capacity downstream of Pactola Dam is considered to be approximately 600 cfs. Releases from Pactola were made targeting flows of 450 cfs into Canyon Lake and 550 cfs through Rapid City.

Rainfall amounts of 2 inches over the Black Hills and 2.90 inches at the dam during the period June 02 through June 09 resulted in additional runoff into the reservoir. This water was also evacuated at a rate of 350 cfs.

(g) Tiber Dam, Montana. The USBR was granted permission to raise the March 1 target pool from 2978 feet msl. On March 1 the pool was at elevation 2979 feet msl. The snowmelt brought the pool above 2993 feet msl in June. Releases were held to a maximum of 4431 cfs. Channel capacity is 10,000 cfs.

(h) Yellowtail Dam, Montana. Bighorn Lake will be regulated for flood control primarily for the reduction and prevention of flooding downstream from the project, on both the Bighorn and Yellowstone Rivers.

Three federal agencies, the Corps of Engineers, Bureau of Reclamation and the Natural Resources Conservation Service (NRCS) are responsible for providing monthly independent April-July inflow forecasts for Bighorn Reservoir. The Corps calculates their forecasts based on November and December inflows (antecedent conditions), observed January to June snowpack and actual and anticipated April to June precipitation. Table 13 displays the agencies' 1995 forecasts.

Table 13
Forecasted % of Normal April - July 1995 Bighorn Lake Reservoir

Agency	Feb 1	Mar 1	Apr 1	May 1	Jun 1
U.S. Army Corps of Engineers	69	71	70	101	119
Bureau of Reclamation	77	82	90	120	154
National Resources Conservation Service	109	108	104	125	167

As stated in the Field Working Agreement (dated September 21, 1971) and Part 208 - Flood Control Regulation of the Federal Register, the Corps will assume regulation of no more of the portion of the joint use zone than that can be assured of subsequent refill prior to July 31 from inflows in excess of scheduled conservation releases.

The assured inflow from the Corps' June 1 forecast was calculated to be 660,000 acre-feet. The Bureau's scheduled conservation releases for June and July were 1,030,000 acre-feet. Therefore, the regulation control of the joint use pool remained with the Bureau.

Several considerations are given in determining releases from Yellowtail Dam: 1) downstream Bighorn River channel capacities of 20,000 cfs and 25,000 cfs at St. Xavier and Highorn, respectively and 65,000 at Miles City on the Yellowstone River, and 2) discharges from upstream Buffalo Bill and Boysen dams.

Bighorn Lake entered the flood control pool (elevation 3640 feet msl) June 30th. The discharge was 8300 cfs, (full power plant capacity is 7800 cfs; Xavier canal max release is 550 cfs). At 1100 hours MDT, July 10, 1995, the discharge was increased from 8300 cfs to 12,500 cfs to accommodate high upstream Shoshone River runoff/Buffalo Bill Dam releases. That same day the Bureau issued a press release advising the public of increased releases. Two days later the increasing inflows prompted releases to be increased to 14,500 cfs. On July 14, discharges were decreased to 11,000 cfs for a 9-hour time period to allow for repair of a gate. The discharges were then returned to 14,500 cfs. Inflows peaked July 16, and fell below discharges July 18. The releases were then lowered over a 3-week period to 4000 cfs. Upstream conditions allowed for the releases to stay ahead of inflows resulting in a steady decline of the pool level. Figure 12 displays Bighorn Reservoir inflow, outflow, elevation and storage. Figure 13 displays the discharge and gage height at the downstream station. Bighorn River above Tullock Creek near Bighorn, Montana.

Bighorn Lake exited the flood control pool August 14, 1995.

Maximum pool elevation = 3646.30 feet, 33.4% FCP occupied, July 17, 1995
Maximum daily inflow = 18,073 cfs, July 16, 1995
Maximum daily outflow = 14,415 cfs, July 19, 1995

The flow regulation provided by Yellowtail Dam significantly reduced discharges downstream of the project. Table 14 shows a comparison of natural versus regulated flows.

Table 14
Yellowstone River Natural and Regulated Flows

	Natural Peak Flow (cfs)	Regulated Peak Flow (cfs)
Bighorn River at Bighorn, MT	18,600	13,700
Yellowstone River at Sidney, MT	63,700	58,800

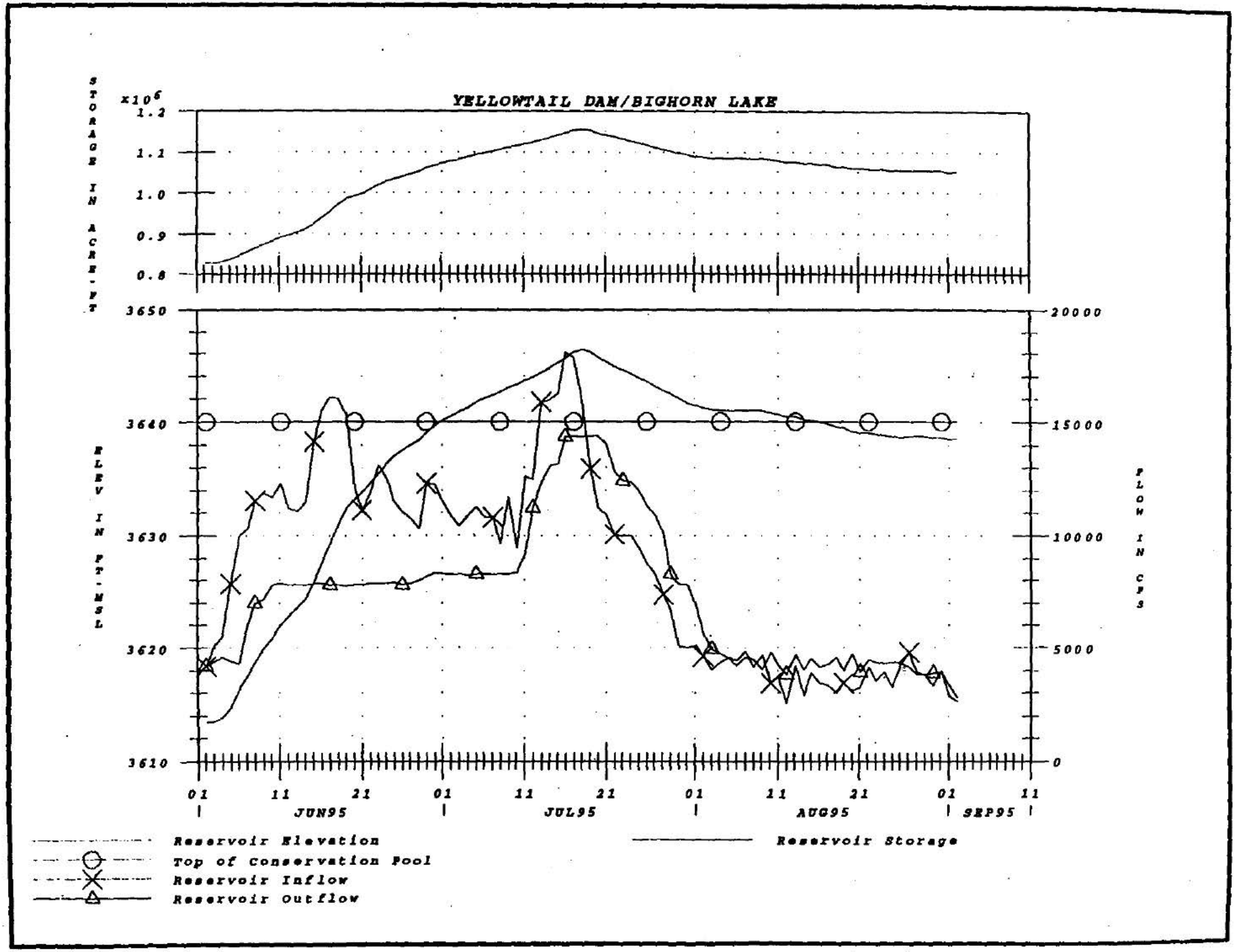

YELLOWTAIL DAM/BIGHORN LAKE
STORAGE IN ACRE-FT
x10^6
1.2
1.1
1.0
0.9
0.8
ELEV IN FT-MSL
3650
3640
3630
3620
3610
FLOW IN CFS
20000
15000
10000
5000
0
01
11
21
01
11
21
01
11
21
01
11
JUN95
JUL95
AUG95
SEP95
Reservoir Elevation
Top of Conservation Pool
Reservoir Inflow
Reservoir Outflow
Reservoir Storage

FIGURE 12

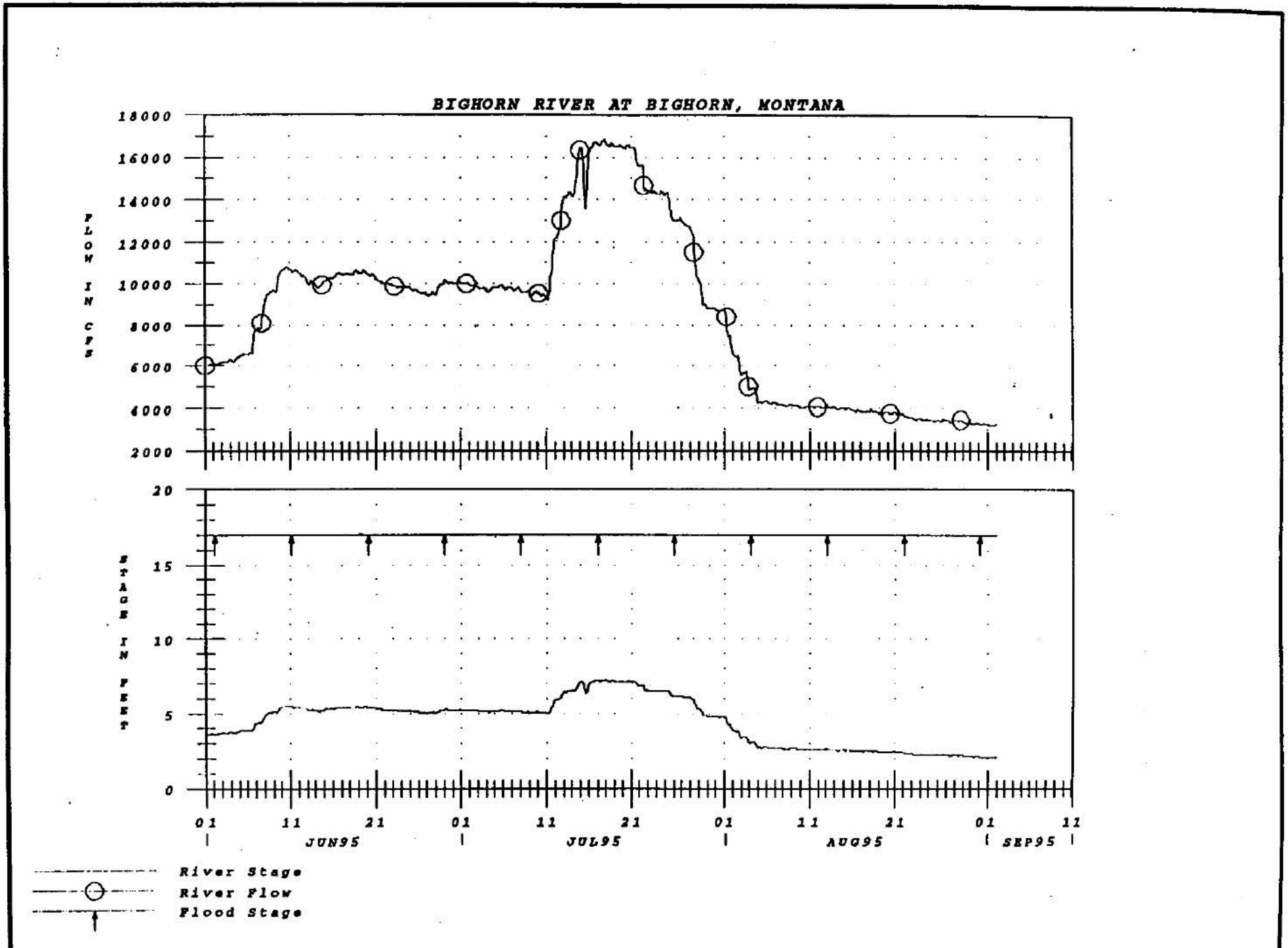

BIGHORN RIVER AT BIGHORN, MONTANA
FLOW IN CFS
18000
16000
14000
12000
10000
8000
6000
4000
2000
STAGE IN FEET
20
15
10
5
0
01
11
21
01
11
21
01
11
21
01
11
JUN95
JUL95
AUG95
SEP95
River Stage
River Flow
Flood Stage

FIGURE 13

b. Deviations from Water Control Plan.

(1) Pipestem and Jamestown Dams. Heavy spring runoff resulted in unusually high pool levels at both projects. Given the saturated soil conditions and potential for additional runoff, there was a high risk for the pools to rise to levels which would require a release of 1800 cfs, which would cause severe flooding in Jamestown. As a result releases were increased to a combined discharge of 900 cfs. After it was determined that there was sufficient channel capacity this was later increased to 1100 cfs.

This release was maintained throughout the summer after it was determined that there was seepage below Jamestown and prompt evacuation of stored floodwaters was advisable.

A summary of the deviations is shown on Table 15.

Table 15
Deviations from Water Control Plan

Date	Description	Major/Minor	Project	Time Period
4/95	To increase discharge to 900 cfs	Minor	Jamestown/ Pipestem	Apr 12 - Apr 21
4/95	To increase discharge to 1100 cfs	Minor	Jamestown/ Pipestem	Apr 21 - May 31
5/95	Maintain high release with falling pool	Minor	Jamestown/ Pipestem	May 31 - Nov 15

c. Proposed Operations.

(1) Corps of Engineers. With the exception of Bear Creek, Cherry Creek, Chatfield and Pipestem, all Corps of Engineers tributary dams have ungated service outlets and no gate operations are normally required except for occasional opening of the low-level outlets for various purposes. Releases to meet downstream water rights can be expected at Bowman-Haley, Cold Brook, Chatfield, Cherry Creek, Bear Creek and Salt Creek #18. Evacuation of stored flood water in these projects is scheduled as soon as practicable after each flood event.

(a) North Dakota. Flood releases from Pipestem Dam will be coordinated with those from the Bureau's Jamestown Dam. The low-level gate at Pipestem will be opened when water is flowing over the drop inlet to assist in the improvement of lake water quality. At Bowman-Haley Reservoir, the water quality improvement program calls for releases from the low-level drawdown tube during periods of pronounced lake stratification that typically occur in late winter and again in late summer around July 15th. If the local sponsor concurs and winter downstream conditions permit, water will be evacuated from the lower elevations each year starting in early February.

(b) South Dakota. Cold Brook Reservoir inflows up to 1.1 cfs will be released to the Larvie Lake Resort when requested to meet their water right.

(c) Colorado. At Chatfield Reservoir, the pool level is expected to fluctuate between elevations 5423.0 and 5432.0 feet msl at all times except during prolonged periods of drought or excessive runoff. Each year, from May 1 to August 31, the pool level is not expected to fall below elevation 5426.85 feet msl (20,000 acre-feet) for recreational purposes. Storage of water above elevation 5426.85 to elevation 5432.0 feet msl will depend on the availability of free water and/or the desire of the City of Denver to store water. During the Colorado irrigation season, inflows to Cherry Creek Reservoir will be calculated by the Water Control Section and the State Engineer on a daily basis and releases will be balanced on a weekly basis to comply with State water rights. The Colorado department of Parks and Recreation has been working to obtain water from several sources including the Denver Metro Sewer return flows to exchange with calls made against Cherry Creek. Releases will be made at Cherry Creek Reservoir in May or June to flush sediment from around the gates in the intake structure. Flushes will not be scheduled during the December through March period. The flushing schedule utilizes approximately 150 to 250 acre-feet of water. At Bear Creek Reservoir, the low-level gate will be opened when practical during the June through August period when the lake typically stratifies to assist in the improvement of lake water quality if requested. If the lake falls below elevation 5558.0, releases from the low level gates may need to be done in order to satisfy downstream water rights requests. All other operations of the Colorado reservoirs will be done in accordance with the individual water control plan.

(d) Nebraska. At Salt Creek Dam #18, releases of inflow up to a total of 11.57 cfs may be made for water rights calls from downstream landowners. Releases up to 3 cfs without proving inflow will be made when required to satisfy downstream water rights. Low-level releases will be made when practicable from the Papillion Creek projects to allow water to be discharged from lower elevations in an attempt to improve lake water quality. All other operations of the Nebraska reservoirs will be done in accordance with the individual water control plan.

(2) Bureau of Reclamation. As in the past, the Bureau will continue to operate their reservoirs to meet flood control commitments and to coordinate operations with other interests to achieve optimum use of water resources. Generally, all reservoirs will be operated as close to the top of their conservation pools as possible. Pertinent special operating plans are described as follows: Boysen, Canyon Ferry, Clark Canyon, Tiber and Yellowtail Reservoirs require evacuation and refill of joint-use storage for flood control based on mountain runoff inflow forecasts.

(a) Canyon Ferry. The Canyon Ferry Reservoir Operating Plan requires that releases are adjusted as soon as the storage has peaked, usually in June or July, so the pool will be drawn to near elevation 3780.0 feet msl by the following March 1. In addition, the Montana Power Company will try to limit releases from Hebgen Reservoir to maintain Canyon Ferry pool below elevation 3794.0 feet msl after December 1. Storage below elevation 3794.0 feet msl prior to winter freeze up is desired to prevent ice jam problems at the upper end of the lake. Beginning near the first of January, releases will be set based on the most probable spring inflow forecast to allow the reservoir to fill to elevation 3797.0 feet msl near the end of June.

(b) Tiber. In accordance with the Water Control Agreement, the joint-use zone at Tiber Reservoir will be vacated to elevation 2976.0 feet msl by March 1. March-June releases are based on forecasted inflows with the objective of filling Lake Elwell to elevation 2993.0 feet msl by the end of June. However, if necessary, March-June releases may be based on filling the reservoir to as high as elevation 3008.0 feet msl by the end of June to provide replacement storage and assist the Corps in the operation of the mainstem reservoir system.

(c) Yellowtail. Yellowtail Reservoir will be regulated to be no higher than elevation 3630.0 feet msl by November 30 to reduce chances of headwater ice problems. The drawdown will continue through the winter months so that the pool elevation will be no higher than 3605.0 feet msl before the beginning of spring runoff based on a normal runoff forecast. March through July releases will be based on forecasted inflows with the objective of filling Yellowtail Reservoir to elevation 3640.0 feet msl by the end of July.

(d) Others. Replacement storage up to a combined total of 1,075,500 acre-feet can be made available in Clark Canyon, Tiber and Canyon Ferry Reservoirs on a forecast basis. Fresno Reservoir in Montana is lowered each year and regulated to provide flood control in accordance with a July 4, 1957 Letter of Understanding. In addition to the reservoirs covered in this report, other Bureau reservoirs, without allocated flood control storage space, will provide flood control in their normal operation of storing seasonal runoff. Some of these projects are Gibson Dam in Montana and Bull Lake, Pathfinder, Seminoe, and Buffalo Bill Dams in Wyoming.

VII. MAJOR REGULATION PROBLEMS.

a. Water Quality. Water quality problems, including algal blooms and low dissolved oxygen, exist at certain tributary reservoirs. The principal water quality issues and problems at each of the project during 1994 are covered in a separate report prepared by the Water Quality Unit. Except for the Water Quality study at Bear Creek, no water quality regulation was necessary.

b. Downstream Channel Capacity. Inadequate or reduced channel capacity is a problem below many of the tributary reservoirs. Encroachment by natural plant growth due to low flows, by flood deposits left in place, and by human construction and agriculture practices, are common. In some cases, downstream channel capacity is significantly less than flood control releases. For example, the channel downstream of Cold Brook Dam is undefinable due to residential construction. The channel capacity of the South Platte River below the Tri-Lakes projects hinders or prevents releases in accordance with the three-reservoir (Chatfield, Bear Creek, and Cherry Creek) plan of regulation to evacuate flood storage. Compounding this situation is the fact that the reservoir design routings for Chatfield, Bear Creek and Cherry Creek Reservoirs were made independently of each other and that the individual routings neglected 1) the effect of the releases from the other two dams in the three-reservoir system, 2) the effect of the incremental runoff below the dams, and 3) the actual channel capacity below the three dams. These issues will be addressed in the Water Control Manual updates for each of the projects.

c. Releases for Purposes other than Authorized Project Functions. No releases were made for purposes other than authorized project functions.

d. Potential Hazardous Conditions. A potential problem exists if water is released over the project spillways where the land downstream of the project has been developed into urban areas. A hazard-to-life condition exists if a significant flow of water is discharged over the spillways at these projects.

e. Dam Safety Issues. There also is a hazard to life condition if a flood event occurs that causes overtopping of the dam embankment. Dams located above populated areas are normally designed to store and/or pass a Probable Maximum Flood (PMF) without overtopping the embankment. The PMF is estimated using probable maximum precipitation estimates developed by the National Weather Service. Recent studies indicate that two Corps of Engineers and eleven Bureau of Reclamation tributary reservoirs cannot safely pass the PMF without being overtopped. Following is information on each of these projects along with the status of potential corrective actions:

(1) Corps of Engineers Dams.

(a) Cherry Creek Dam. Corps of Engineers dams located above populated areas are designed to store and/or pass a PMF without overtopping the embankment. The most recent precipitation estimates for this area, published in Hydrometeorological Report No. 55 (HMR 55) in March 1984, were applied to the Cherry Creek Lake project. It was found that the reservoir could safely pass no more than 63% of the PMF under existing development with adequate freeboard. In 1995 a new site specific PMP analysis was completed by the National Weather Service. The revised PMF has not been developed.

The probability of overtopping of the Cherry Creek embankment is very remote. However, the consequences of failure would be catastrophic. The population within the potential Cherry creek flood area downstream from the dam is estimated to be as high as 138,000. Potential flood damages are nearly $3 billion for the with dam failure condition.

The Reconnaissance Report "Hydrologic Improvement Assessment, Cherry Creek Lake, Colorado", September 1990 has been reviewed by Missouri River Division and was approved in June 1994 by Headquarters, USACE. The report concluded that the reservoir could safely pass no more than 63 percent of the probable maximum flood under existing development with adequate freeboard, and a dam crest raise of 19 feet was recommended. The report was approved as a basis to prepare a dam safety evaluation report in accordance with draft ER 1110-2-1155 dated March 1994. A number of alternatives will be considered to enable the project to safely pass the PMF. The alternatives included widening of the existing spillway, adding a new spillway at one of three locations in the embankment, constructing an additional reservoir (Castlewood) about 30 miles upstream from Cherry Creek Lake, hardening the dam face, raising the dam crest, and no action. The alternatives will be considered individually and in combination with each other. The District has programmed FY-97 O&M funds to initiate this effort.

(b) Cold Brook Dam. On 11 August 1993, the revised draft reconnaissance report for the Cold Brook Dam hydrologic improvement assessment was furnished on Missouri River Division (MRD) for review. The report concluded that the Cold Brook project was hydraulically deficient as it could safely pass only 48 percent of the PMF with adequate freeboard. MRD and HQUSACE have requested that the potential loss of life (LOL) analysis for existing and modified conditions be refined. This work will be completed in FY-96.

(2) Bureau of Reclamation Dams.

(a) Clark Canyon Dam. The PMF for Clark Canyon Dam is characterized by a peak inflow of 166,800 cfs and a volume of 506,000 acre-feet. Clark Canyon Dam will be overtopped by floods exceeding 58 percent of the PMF. The Bureau of Reclamation's recommended corrective action is the implementation of an Early Warning System (EWS). Work has been initiated on the EWS.

(b) Canyon Ferry Dam. The PMF for Canyon Ferry Dam is characterized by a peak inflow of 506,000 cfs and a 15-day volume of 2,035,000 acre-feet. Canyon Ferry Dam will be overtopped by floods exceeding 94 percent of the PMF. The potential for dam failure during overtopping is considered to be low. Corrective actions are not anticipated.

(c) Tiber Dam. The PMF for the Tiber Dam is characterized by a peak inflow of 695,926 cfs and a 15-day volume of 1,443,000 acre-feet. Tiber Dam will be overtopped by floods exceeding 59 percent of the PMF. An EWS is anticipated as the recommended corrective action.

(d) Boysen Dam. The PMF for Boysen Dam is characterized by a peak inflow of 845,000 cfs and a 15-day volume of 2,820,000 acre-feet. Boysen Dam will be overtopped by floods exceeding 48 percent of the PMF. The Bureau of Reclamation's recommended corrective action is the implementation of an EWS in conjunction with the EWSs at upstream dams (Pilot Butte and Bull Lake Dams). Work has been initiated on the EWS.

(e) Yellowtail Dam. The PMF for Yellowtail Dam is characterized by a peak inflow of 887,000 cfs and a volume of 4,700,000 acre-feet. Yellowtail Dam will be overtopped by floods exceeding 31 percent of the PMF. The potential for dam failure during overtopping is considered to be low. Corrective actions are not anticipated.

(f) Heart Butte Dam. The PMF for Heart Butte Dam is characterized by a peak inflow of 161,400 cfs and a volume of 558,600 acre-feet. Heart Butte Dam was modified in 1987 to safely pass the PMF.

(g) Jamestown Dam. The PMF for Jamestown Dam is characterized by a peak inflow of 110,200 cfs and a volume of 589,500 acre-feet. Jamestown Dam will be overtopped by floods exceeding 91 percent of the PMF. Piping failure of Jamestown Dam during high reservoir conditions is also a dam safety concern. Corrective actions will likely include the implementation of an EWS and installation of toe drains or relief wells.

(h) Keyhole Dam. The PMF for Keyhole Dam is characterized by a peak inflow of 513,600 cfs and a volume of 785,800 acre-feet. Keyhole Dam will be overtopped by floods exceeding 75 percent of the PMF. The Bureau of Reclamation's recommended corrective action is the implementation of an EWS.

(i) Pactola Dam. The PMF for Pactola Dam is characterized by a peak inflow of 321,240 cfs and a volume of 159,800 acre-feet. The PMF for Pactola Dam has not been updated since 1981. Pactola Dam was modified in 1985-1987 to safely pass the current PMF.

(j) Shadehill Dam. The PMF for Shadehill Dam is characterized by a peak inflow of 423,200 cfs and a volume of 1,324,900 acre-feet. Shadehill Dam will be overtopped by floods exceeding 77 percent of the PMF. The likely corrective action will be the implementation of an EWS.

(k) Glendo Dam. The PMF for Glendo Dam is characterized by a peak inflow of 627,100 cfs and a volume of 2,197,000 acre-feet. Glendo Dam will be overtopped by floods exceeding 40 percent of the PMF. The Bureau of Reclamation has completed an extensive analysis of potential corrective actions for all of its mainstem North Platte River Dams. These studies have resulted in the recommendation to modify Glendo Dam to pass 80 percent of the PMF (modification of Pathfinder Dam and Seminoe Dam is also recommended). The recommendation for modifications is based upon an analysis of the consequences of dam failure. The Bureau of Reclamation's studies indicate that failure of any of the larger mainstem dams (Seminoe Dam, Pathfinder Dam or Glendo Dam) will cause the subsequent failure of all downstream dams, including Kingsley Dam in central Nebraska.

VIII. WATER CONTROL MANUALS. Work progressed on several Water Control Manual updates during the year. The Westerly Creek Water Control Manual is being reformatted to conform to EC 1110-2-278. The Papillion Creek Water Control Manual has been approved by Missouri River Division. The final draft of the Canyon Ferry Water Control Manual has been reviewed by Missouri River Division and is being reformatted to conform to EC 1110-2-278. The first draft of the Glendo Water Control Manual has been prepared and is being reviewed within the Omaha District. The final draft of the Lake Audubon Water Control Manual has been sent to Missouri River Division for final approval.

Funding has been received for Phase II of the Chatfield, Cherry Creek, and Bear Creek Water Control Manual Updates. Phase II work will include evaluating alternative water control plans, and initiating environmental assessments. Phase III work in FY97 will include selection of a preferred water control plan and evaluation of the need for a Tri-Lakes Master Manual.

Funding has also been received for initiation of water control manual updates for Pipestem and Jamestown Reservoirs. Phase I work in FY96 will include developing and updating hydrologic models, updating stage-damage relationships and initiating environmental assessments. Water Control Manuals will be updated on an approximate 10-year cycle, or more frequently, if required. If funds are not available for a comprehensive review and update of a water control manual, at a minimum "baseline" O&M funds will be used to update area-capacity curves, rating curves, stage-damage curves, historical records, and documentation of large runoff events.

Table 16 indicates work priorities while Table 17 lists the current status of all Water Control Manuals.

TABLE 16

WORK PRIORITIES Update Water Control Manuals		
Priority	**Project**	**Remarks**
1	Tri-Lakes	Scheduled completion FY-97
2	Papio	Scheduled completion FY-96
3	Westerly Creek/Kelly Road	Scheduled completion FY-96
4	Lake Audubon	Scheduled completion FY-96
5	Canyon Ferry	Scheduled completion FY-96
6	Glendo	Scheduled completion FY-96
7	Chatfield	Scheduled completion FY-97
8	Bear Creek	Scheduled completion FY-97
9	Cherry Creek	Scheduled completed FY-97
10	Pipestem/Jamestown	Scheduled start FY-96
11	Pactola	Scheduled start FY-98
12	Cold Brook	To reflect changed outlet pipe and line from stilling basin. Scheduled start FY-98
13	Cottonwood Springs	Scheduled start FY-98
REAL-TIME MODELS		
1	Cherry Creek	HEC-1F Model
2	Chatfield	HEC-1F Model
3	Bear Creek	HEC-1F Model
4	Glendo	Snowmelt forecast model
5	Pipestem/Jamestown	HEC-1F Model
6	Cold Brook/Cottonwood	HEC-1F Model

TABLE 17
SCHEDULE FOR REVISION OF WATER CONTROL MANUALS
FY 1995 - FY 2004

Dam/Reservoir Name	Stream	Owner	District	Date of Manual or Last Revision	Scheduled Completion Date of Next Revision	Type of Revision - Manual (M) or Plan (P)	Estimated Total Cost $1000
Chatfield	South Platte River	CE	MRO	Apr 73	FY 1997	M/P	110
Cherry Creek	Cherry Creek	CE	MRO	Oct 71	FY 1997	M/P	120
Bear Creek	Bear Creek	CE	MRO	Mar 77	FY 1997	M/P	90
Pipestem	Pipestem Creek	CE	MRO	Aug 86	FY 1997	M/P	60
Cold Brook	Cold Brook	CE	MRO	Aug 54	FY 1998	M	30
Cottonwood Springs	Cottonwood Springs	CE	MRO	Sep 73	FY 1998	M	20
Cedar Canyon	Deadman's Gulch	CE	MRO	Jan 71	FY 1999	M	20
Salt Creek Dams (10)	Salt Creek/Tribs	CE	MRO	Dec 78	FY 2000	M	40
Bowman-Haley	N. Fork Grand River	CE	MRO	Mar 87	FY 2001	M	30
Lake Pocasse	Spring Creek	CE	MRO	Jun 89	FY 2001	M	20
Lake Audubon	Snake Creek	CE	MRO	Dec 92	FY 2002	M	30
Bull Hook/Scott Coulee	Bull Hook Creek	CE	MRO	Mar 91	FY 2002	M	20
Kelly Rd/Westerly Creek	Westerly Creek	CE	MRO	Dec 92	FY 2003	M	30
Papillion Creek Dams (4)	Papillion Creek/Tribs	CE	MRO	Dec 92	FY 2004	M	30
Canyon Ferry	Missouri River	BR	MRO	Apr 95	FY 2005	M	40
Glendo	North Platte River	BR	MRO	Apr 70	FY 1996	M	40
Jamestown	James River	BR	MRO	Nov 57	FY 1997	M/P	60
Pactola	Rapid Creek	BR	MRO	Feb 77	FY 1998	M	50
Boysen	Wind River	BR	MRO	Dec 66	FY 1999	M	50
Yellowtail	Bighorn River	BR	MRO	Jan 74	FY 2000	M	40
Clark Canyon	Beaverhead River	BR	MRO	Jun 76	FY 2001	M	40
Tiber	Marias River	BR	MRO	Dec 59	FY 2002	M/P	60
Heart Butte	Heart River	BR	MRO	Feb 51	FY 2003	M	30
Shadehill	Grand River	BR	MRO	Nov 51	FY 2003	M	30
Keyhole	Belle Fourche River	BR	MRO	Jun 69	FY 2004	M	30

IX. DATA COLLECTION PROGRAM AND PROCEDURES.

a. Collection of Water Control Data. Data from hydrologic gages for water control management is obtained from various sources including contract observers, project offices, National Weather Service, Geological Survey, Bureau of Reclamation and satellite Data Collection Platforms (DCPs). The National Weather Service (NWS) provides current weather conditions, 3-day forecasts and precipitation and snowfall reports along with current river levels, river level forecasts, and flood forecasts. Since March 1986, this service, called "Hydromet", has been retrieved from a NWS computer in Kansas City.

The Section uses a WSI weather system. Radar images from nineteen (19) sites in eight states surrounding the Missouri River basin are available with this system. In addition, the NWS automatically sends satellite images via a direct telephone line to the system. The section utilizes 5 difference sources for weather information. These sources include Weatherbank, WSI, Alden, National Weather Service and the internet.

Weatherbank provides products which include surface and upper level pressure charts observed precipitation, q.p.f. charts, text information and other miscellaneous information.

The section uses WSI mainly for near real-time radar information. The WSI product is called Virtual Rain Gage (VRG). The VRG allows the user to designate precipitation sites and obtain near real-time precipitation amounts at these locations from radar information.

Water Control also has a dedicated phone line link to the National Weather Service office in Valley, Nebraska which continuously transmits satellite images. Satellite images are received by a dedicated Alden computer. The Alden computer contains software which allows display and looping of the satellite images.

The final source of weather information is from the internet and the Worldwide Web (WWW). There are many sites scattered throughout the United States and the World which provide a variety of weather products, at no cost. These sites include universities such as Purdue, and weather product companies such as WSI and "The Weather Channel". Products range from precipitation and temperature maps upper level charts, radar, and satellite images, forecasts, and many other products including "value added" graphics.

Since early 1992, the Omaha District, Water Control Section has been developing an HECDSS database for storing river and reservoir data. A commercial software package reads data retrieved from the Section's Domsat Read Only Terminal (DROT) system. The combined data set is then screened using HEC's recently released DATCHK and DATVUE programs.

The DROT was installed in the Fall of 1992. An 8-foot diameter satellite dish was installed on the roof of the Zorinsky Federal Building. The dish receives all DCP transmissions in the continental United States. A cable runs directly from the satellite dish to the two data capture workstations in the Water Control Office.

b. Automated Remote Sensors. State-of-the-art, remote site, satellite data transmissions are utilized for water control management. Satellite collection equipment being used by the District was purchased form Sutron Corporation. The equipment was and is installed and maintained by Section personnel and/or by contract. Currently, there are 21 DCPs in Montana, 5 in Wyoming, 21 in Colorado, 13 in North Dakota, 22 in South Dakota, 46 in Nebraska and 21 in Iowa for a total of 149 sites.

The DCPs in the District transmit real-time river and reservoir levels, precipitation, evaporation, wind, water and air temperature data. The hourly data collected by these remote sensors in transmitted to two ground receiving sites located in Omaha, Nebraska (Corps of Engineers) and Boise, Idaho (Bureau of Reclamation). This information is currently transmitted via GOES-west and GOES-central satellites located at 135 degrees west longitude and 112 degrees west longitude, respectively.

c. Cooperative Hydrologic Programs. Funding for the Omaha District's stream gaging activities is furnished through two programs. The Cooperative Stream Gaging (FC-33) program provides support to seven Geological Survey Districts. The districts are Colorado, Iowa, Montana, Nebraska, North Dakota, South Dakota and Wyoming. Collection and publication of data such as stage, discharge, sediment, water quality and ground water records are the primary functions of this program. The cooperative program also provides funding for DCP and telemark maintenance. The National Weather Service Reporting Network (FC-50) program provides financial support for the collection of data from 40 gaging stations within six river district offices. Formerly operated by the Corps of Engineers, these stations are required for reservoir regulation. The stations are in addition to the regular National Weather Service reporting stations. Table 18 shows the cost for these programs.

Table 18
Cost of USGS and NWS Cooperative Programs

District	NWS Coop Rpt Network	Domsat	AFOS	USGS Coop Strm Gaging	Total
Omaha	$22,611	$500	$2400	$1,107,025	$1,132,536

d. Water Quality. The Omaha District Water Quality Unit conducts sampling analysis of physical, chemical and biological parameters on reservoirs in the Omaha District. Projects are normally sampled six times per year by in-house personnel or under contract. Occasional surveys and special investigations on all projects are conducted as necessary to identify or resolve specific water quality problems.

In-house personnel sample the Papillion Creek and Salt Creek Reservoirs. Bowman-Haley, Cold Brook, Chatfield, Bear Creek, Cherry Creek, Lake Audubon, Lake Pocasse, Lake Yankton, Pipestem and the Missouri River mainstem reservoirs are sampled by area personnel or under contract. Periodic sampling at Cottonwood Springs Reservoir has ceased since this project currently impounds very little water.

Inflows and releases are sampled by area or in-house personnel at all tributary projects. Inflows and releases of mainstem projects are sampled by area personnel or under contract by the USGS.

Continual remote monitoring and data storage of dissolved oxygen, temperature, conductivity and pH are conducted downstream of Gavins Point, Garrison and Fort Peck Projects. Continual remote monitoring of dissolved oxygen and temperature and periodic monitoring of conductivity and pH is conducted at Big Bend, Fort Randall and Oahe Projects. The monitoring is conducted by area personnel.

e. Sediment. All suspended sediment samples collected in the Omaha District are obtained by the Geological Survey under the Cooperative Stream Gaging Agreement. Complete sedimentation surveys of small reservoir projects are made at approximately 10-year intervals. These include aggradation surveys to update water volume storage and sediment accumulation values, monitor headwater disposition and lake shoreline erosion; and degradation surveys to monitor downstream channel changes.

X. WATER CONTROL INITIATIVES.

a. Missouri River Division Water Control Data System Master Plan. Development continues on HECDSS. Data from various sources are being translated and written to the HECDSS database.

b. Water control is becoming more involved with GIS and would like to develop geographic hydrologic, hydraulic and economic tools to help in decision making and briefing of other District elements and the District Commander.

XI. FERC Applications. During the period of this report, 2 applications for preliminary permits, licenses or exemption from licensing were made to the Federal Energy Regulatory commission by various entities for studies in connection with new or existing hydropower facilities within the Omaha District. These applications were reviewed and comments were prepared by the Omaha District on the impacts of the proposed plant.

XII. TRAINING AND METHODS. During the period of this report, employees in the Section attended the courses listed in Table 19.

Table 19
Training Courses Attended

Course Title	Course Location	Dates
Flood Frequency Analysis	Davis, CA	Aug 95 (40 hrs)
HTRW Safety Refresher	Omaha, NE	Aug 95 (8 hrs)
Safety/Health	Knoxville, TN	Jan 95 (40 hrs)
Damage Survey Report	Omaha, NE	Apr 95 (8 hrs)
Management Assessment Program	Lancaster, PA	Feb 95 (40 hrs)
Dealing w/Upset Citizens	Omaha, NE	May 95 (4 hrs)
HIV/AIDS in Workplace	Omaha, NE	Mar 95 (2 hrs) (7 people)
Army Cultural Studies	Omaha, NE	Jun 95 (16 hrs)

XIII. PERSONNEL. The personnel strength of the Water Control Section currently consists of one Supervisory Hydraulic Engineer, three Hydraulic Engineers, three Hydrologic Engineering Technicians, a part-time civil engineering CO-OP student, a part-time student engineering aide, and a part-time Secretary; a total of 10 personnel. Water Control Data System site manager services are provided by contract services. Table 20 lists personnel in the Water Control Section.

PLATES

OMAHA DISTRICT BOUNDARY

MONTANA

NORTH DAKOTA

SOUTH DAKOTA

WYOMING

NEBRASKA

IA.

COLORADO

Frenchman River
Marias River
Milk River
Teton River
Sun River
Gibson Res.
MISSOURI
Shelby
Havre
TIBER DAM (B.R.)
BULL HOOK DAM (C.E.)
Virgelle
Dutton
Ulm
Great Falls
Cascade
CANYON FERRY DAM (B.R.)
HELENA
Toston
Mosby
Van Norman
Nashua
Ft. Peck
FORT PECK LAKE
RIVER
Wolf Point
Culbertson
Williston
Sidney
LAKE SAKAKAWEA
Lake Audubon
Riverdale
Pipestem Cr.
Pingree
Grace City
JAMESTOWN DAM (B.R.)
Jamestown
PIPESTEM DAM (C.E.)
Mandan
BISMARCK
Heart River
Dickinson Res.
Cannonball River
HEART BUTTE DAM (B.R.)
Breien
LaMoure
Missouri River
Marmarth
Bowman
Haley
BOWMAN-HALEY DAM (C.E.)
Miles City
Musselshell River
Big Hole River
Beaverhead R.
Jefferson River
Gallatin River
Madison River
Dillon
CLARK CANYON DAM (B.R.)
Billings
Yellowstone River
Custer
Livingston
Corwin Springs
Clark Fork
YELLOWTAIL DAM (B.R.)
Tongue River
Sheridan
Buffalo
Greybull
Shoshone River
Buffalo Bill Res.
Big Horn River
Wind River
BOYSEN DAM (B.R.)
Riverton
Powder River
Little Missouri River
KEY HOLE DAM (B.R.)
Belle Fourche River
CEDAR CANYON DAM (C.E.)
Belle Fourche
Cherry Creek
PACTOLA DAM (B.R.)
Rapid City
COLD BROOK DAM (C.E.)
Cheyenne River
White River
Hot Springs
COTTONWOOD SPRINGS DAM (C.E.)
Pathfinder Res.
Platte River
Casper
Alcova Res.
GLENDO DAM (B.R.)
Orin
Guernsey Res.
Seminoe Res.
North Platte River
Laramie River
Mitchell
Bridgeport
CHEYENNE
Lake McConaughy
North Platte
Platte River
Odessa
Grand Island
Waterloo
OMAHA
LINCOLN
Hamburg
Rulo
Missouri River
Niobrara River
Norfolk
Pierce
West Point
Elkhorn River
Boyer River
Council Bluffs
Nishnabotna River
Little Sioux River
Hawarden
SIOUX CITY
Norden
Spencer
Niobrara
LEWIS AND CLARK LAKE
Scotland
Yankton
LAKE FRANCIS CASE
Oacoma
Mitchell
Sioux Falls
Big Sioux River
PIERRE
LAKE SHARPE
Huron
Lake Pocasse
Pollock
LAKE OAHE
Columbia
Stratford
Grand River
Moreau River
SHADEHILL DAM (B.R.)
Cheyenne River
Little White River
Boulder
DENVER
Henderson
Ft. Morgan
BEAR CREEK DAM (C.E.)
KELLY ROAD DAM (C.E.)
CHATFIELD DAM (C.E.)
CHERRY CREEK DAM (C.E.)
Cheesman Res.
Elevenmile Canyon Res.
Antero Res.
Spinney Mtn. Res.

SCALE IN MILES
50 0 50 100

LEGEND:
(C.E.) CORPS OF ENGINEERS
(B.R.) BUREAU OF RECLAMATION

GLENN CUNNINGHAM PA 11
STANDING BEAR PA 16
OMAHA
Carter Lake
Elkhorn
Waterloo
Boys Town
Valley
Ralston
Millard
Boxelder PA 18
La Vista
Papillion
Bellevue
Gretna
WEHRSPANN LAKE PA 20
Capehart
Springfield
Big Papillion Cr.
North Papillion Cr.
Brands West Br.
West Br.
Little Papillion Creek
Papillion Creek
Papillion Creek

PAPILLION CREEK DAMS (C.E.)

BRANCHED OAK (18)
Garland
Seward
Malcolm
Raymond
Davey
Waverly
Prairie Home
TWIN LAKES (13)
PAWNEE (14)
LINCOLN
HOLMES LAKE (17)
CONESTOGA (12)
Pleasant Dale
Emerald
Grover
Milford
Denton
Roca
Rokeby
Chaneyso
YANKEE HILL (10)
WAGON TRAIN (8)
Crete
Marlell
Pragua
Hickman
Holland
BLUESTEM (4)
Kramer
Princeton
Hallam
OLIVE CREEK (2)
STAGECOACH (9)
Oak Creek
North Oak Creek
West Oak Creek
Elk Creek
Middle Creek
Salt Lake
Little Salt Creek
Salt Creek
Jordan Creek
Stevens Creek
Wittstruck Cr.
Spring Br.

SALT CREEK DAMS (C.E.)

Northglen
Thornton
Westminster
Arvada
Commerce City
Wheat Ridge
Golden
Clear Creek
Lakewood
Denver
Aurora
Sand Creek
Cherry Creek
Englewood
Sheridan
Littleton
Morrison Creek
Turkey Creek
Parker
Conifer
South Platte
Lourlens
KELLY ROAD DAM
BEAR CREEK LAKE
CHERRY CREEK LAKE
CHATFIELD LAKE
STRONTIA SPRINGS RES.

TRI-LAKES DAMS (C.E.)

FEDERAL TRIBUTARY PROJECTS WITH FLOOD CONTROL STORAGE

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA
REVISED AUGUST 1988

SUMMARY OF ENGINEERING DATA - FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL
MISSOURI RIVER TRIBUTARIES - U.S. ENGINEER DISTRICT - OMAHA
CORPS OF ENGINEER DAMS - COLORADO, NORTH DAKOTA, MONTANA

ITEM NO	SUBJECT	BEAR CREEK	CHATFIELD	CHERRY CREEK	KELLY ROAD	WESTERLY CREEK	BOWMAN HALEY	PIPESTEM	SNAKE CREEK LAKE AUDUBON	BULL HOOK-SCOTT COULEE
	GENERAL									
1	Location of dam	3 mi S W of Denver CO	2 mi S of Denver CO	10 mi S E of Denver, CO	Lowry A F B Denver CO	Lowry A F B Denver, CO	6 mi W of Hailey ND	3 mi N W Jamestown, ND	12 mi NE of Garrison Dam	1 mi S of Havre, MT
2	River and river mile	Bear Creek R M 8	South Platte River R M 321	Cherry Creek R M 11 4	Westerly Creek	Westerly Creek	N Fk Grand R M 100	Pipestem Creek R M 3	Snake Creek	Bull Hook Cr.-Scott Coulee
3	Drainage area (sq mi)	236	3,019	386	10 84	9 29	446	594	250	54
4	Reservoir length (mi)	0 5 at elevation 5558	2 0 at elevation 5430	1 5 at elevation 5550	Normally dry	Normally dry	2 5 mi at elevation 2755	5 5 at elevation 1442 4		Normally dry
5	Location of Dam/Embdr	At Chatfield Dam	Oh site	At Chatfield Dam	Rocky Mt Area	Rocky Mt Area	Garrison Dam	On site	Garrison Dam	Ft Peck Dam
6	Travel time to Missouri River	2 weeks	2 weeks	-	-	-	1 day to Shadehill Dam	9 weeks	-	-
7	Max discharge of record	8,500 cfs July 1896	110,000 cfs June 1965	58,000 cfs June 1965	-	-	14,100 cfs April 1952	6,080 cfs April 1950		
8	Project cost (1)	$81,700 00	$101,130 000	$14,670 000	9232 000 (Originll Cost)		$4,372,200	$9,277,900		$1,837 200
	DAM AND EMBANKMENT									
9	Top of dam - ft MSL	5689 5	5527	5644 5	5372 0 5363 0 West Emb	5434 5	2794 0	1507 5	1865	2813 3 (BH) 2813 3 (SC)
10	Length of dam - ft	5,300-main 2,100-South	13,138	14,300	4 700	9100	8 730	4,000	12,900	1,900 (BH) 1500 (SC)
11	Height of dam - ft	179 5-main 85-South	147	141	32	45 5	79	107 5	85	73 (BH) 53 (SC)
12	Stream bed - ft MSL	5 5 0	5 380	5504	5 340	5389	2715	1,400	1780	2 540 (BH) 2,560 (SC)
13	Abutment formation	Clay shale, siltstone,sandstone	Sandy overburden-Dawson F	Sandstone, clay, silt	Overburden-sandy clay		Ludlow, sandy clay, silty sand	Sandy overburden-P shale		Glacial till, loess clay
14	Type of fill	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled Earth	Rolled earth
15	Fill quantity in cu yds	11,348,000-main 770,000-So	14,850,000	13,808,000	208,000		1,750,000	1,990,000		1,500,000
16	Date of closure	July 1977	August 1973	October 1948	November 1953 Retsas 1976	July 1991	August 1966	July 1973	1952	October 1955
17	Date of inital fill (base F C)	May 1979	June 1979	March 1980	-	-	March 1969	May 1974	September 1975	-
	SPILLWAY									*Notch in BH to 2583
18	Discharge capacity - cfs	153,500 cfs at el 5684 5	146,000 cfs at el 5521 0	36,380 cfs at el. 5638 2	3,600 cfs at elevation 5366 0	46,900 cfs at el 5431 4	62,970 cfs at elevation 2780	58,200 cfs at el. 1502 8	none	25 200 cfs at elevation 2605
19	Crest elevation - ft MSL	5667 6	5,500 0	5606 7	5362 0	5419 0	2,777	1498 3		2583.0 (BH)* 2586 0 (SC)
20	Width - ft	800	500	87	120	400	850	1500		-
21	Gates, number, size, type	Ungated earth channel	Ungated converging chute	Ungated earth channel	Uncontrolled concrete U wall and chute	Uncontrolled grass lined earth cut	Ungated earth notch (2)	Ungated earth channel		Ungated earth channels
	RESERVOIR ELEVATION AND AREA									
22	Maximum pool	5684 5 1237a	5521 6 9872a	5636.2 (3) 4544a	5366 8 43a	5431 4	2780 8 7916a	1502 8 7105a	1850 20 620a	2605.0 (BH & SC) 384a
23	Top of flood control pool	5635 5 715a	5500 0 4766a	5606 7 3101a	5362 0 38a	5419 0	2777 0 5131a	1498 3 4754a	none	2593 0 (BH & SC) 283a
24	Top of multipurpose pool	5558 0 167a	5432 0 1422a	5550 0 844a	none	none	2754 8 1732a	1442 4 885a	1847 19 780a	none
25	Top of inactive pool	5528.0 17a	none	none	none	none	2740 0 965a	1415 0 82a	1810 1,450a	none
	STORAGE ZONES (Elev. - Capacity)									Total - (BH & SC)
26	Surcharge	5635 5 - 5684 5 47,350AF	5500 - 5521 6 118,215AF	5598.9-5636 0 (3) 134,434AF	5362 0 - 5366 8 200AF	5419 0 - 5431 4 3950AF	2777 0 - 2789 0 77,085AF	1498 3 - 1502 8 36,850AF	1847 - 1850 59,136AF	2593 0 - 2605 0 4000AF
27	Flood Control	5558 0 - 5635 5 28,757AF	5432 - 5500 0 209,845AF	5550 0 - 5606 7 122,842AF	5342 0 - 5362 0 380AF		2754 8 - 2777 0 72,717AF	1442 4 - 1498 3 132,010AF	none	2540 0 - 2593 0 8500AF
28	Multipurpose	5528 0 - 5558 0 1,857AF	5385 - 5432 28,124AF	5504 0 - 5550 0 92,805AF	none	none	2740 0 - 2754 8 15,456AF	1415 0 - 1442 4 8,590AF	1810 - 1847 323 880AF	2540 0 - 2593 0 None
29	Inactive	5510 - 5528 0 70AF	5377 - 5385 25AF	none	none		2715 0 - 2740 0 3,309AF	1400 0 - 1415 0 280AF	1780 - 1810 13,180AF	None
30	Gross (top of flood control pool)	30,864AF	235,096AF	92,126AF	380AF		91,482AF	148,680A	396,000AF	8500AF
	OUTLET WORKS									
31	Number and size - conduits	1 - 7 ft circular - upstream 1 - 7 x 10 5 ft - downstream	2 - 11 x 16 ft. oval conduit	2 - 8 x 12 ft. oval conduit 1 - 12 ft circular conduit	1 - 6.5 ft. circular conduit 1 - 30 in. CMP	1 - 4 ft. prestressed concrete cylinder pipe	1 - 10 ft. circular conduit	1 - 8 ft. circular conduit	1 - 7 x 10 ft. reinforced concrete conduit	1 - 30 in. RCP - Bull Hook 1 - 30 in. RCP - Scott Coulee
32	Conduit length - ft	1890 ft Ungated drop inlet - el 5556	1280 ft	679 5 ft	Ungated drop inlet el. 5358 4	907 ft	341 ft Ungated Glory Hole-el 2754 8	675 ft Ungated drop inlet-el 1442 4	1 - 7 x 10 ft. sluice gate	393 ft - Bull Hook 286 ft - Scott Coulee
33	Number - size - type gates	2 - 3 x 6 ft. hydraulic slide 2 - 1 x 1 ft. slide-gate on gate	2 - 6 x 13.5 ft. hydraulic slide 2 - 2 x 2 ft. slide-gate on gate 1 - 72 in. butterfly	5 - 6 x 9 ft. - hydraulic slide 2 - 18 in bypass gates	Gated inlet - el 5342 0	1 - 48 x 24 inches hand operated sluice	2 - 30 in valves - el 2740 0 1 - 30 in sleeve gate valve 1 - 30 in interior slide gate	2 x 7 ft hydraulic slide 1 - 36 in valve 1-3 x 3 ft slide		1 - 24 in. valve Bull Hook 1 - 24 in. valve Scott Coulee
34	Discharge capacity	2,109 cfs at el 5667	6400 cfs at el 5500 0	8100 cfs at el 5598 0	570 cfs at el 5362 0	98 cfs at el 5431 4	Glory Hole-32000cfs at el 2788 30 m valve-140cfs at el 2755	2,300 cfs at el 1498 3	2,300 cfs at 15 ft head differential	123 cfs at 2593- Bull Hook 183 cfs at 2593- Scott Coulee
35	**POWER INSTALLATION**	none	none	none	none	none	none	none	none	none

(1) Costs are as of 8-30-80

(2) Bowman-Haley Spillway equipped with Fuse Plug (Crest Elevation 2780 7 ft MSL)

(3) Due to updated Hydrological Improvement Assessment for Cherry Creek Reservoir with the maximum pool the dam would be overtopped

January 1996

PLATE 2

SUMMARY OF ENGINEERING DATA - FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL
MISSOURI RIVER TRIBUTARIES - U.S. ENGINEER DISTRICT - OMAHA
CORPS OF ENGINEERS DAMS - SALT CREEK BASIN, NEBRASKA

ITEM NO	SUBJECT	DAM NO. 2 (Olive Creek Lake)	DAM NO. 4 (Blue Stem Lake)	DAM NO. 8 (Wagon Train Lake)	DAM NO. 9 (Stagecoach Lake)	DAM NO. 10 (Yankee Hill Lake)	DAM NO. 12 (Conestoga Lake)	DAM NO. 13 (Twin Lakes)	DAM NO. 14 (Pawnee Lake)	DAM NO. 17 (Holmes Park Lake)	DAM NO. 18 (Branched Oak Lake)
	GENERAL										
1	Location of dam	1.5 mi. W of Sprague	2.5 mi. W of Sprague	1.5 mi. N of Holland	1 mi. S of Hickman	3.5 mi. N of Denton	1.5 mi. N of Denton	2 mi. NW of Pleasantdale	2 mi. NW of Emerald	SE edge of Lincoln	4 mi. W of Raymond
2	River and mileage	S. Trib. of Olive Br. RM 12	N. Trib. of Olive Br. RM 9.5	N. Trib. of Hickman Br. RM 8	S. Trib. of Hickman Br. RM 1	Cardwell Br. RM 4	Holmes Cr. RM 1	Middle Cr. RM 12.8	N Middle Cr. RM 1	Antelope Cr. RM 8.1	Oak Cr. RM 17.3
3	Drainage area in square miles	8.2	18.8	15.8	9.7	8.4	15.1	11.0	35.8	5.4	88.7
4	Reservoir length in miles	1.2	1.8	1.8	1.4	0.7	1.4	1.5	3.0	0.7	3.7
5	Location of Damtender	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office
6	Travel time to Lincoln, NE	23 hrs	13 hrs.	24 hrs.	6 hrs.	3 hrs.	8 hrs.	13 hours	7 hrs.	3 hrs.	6 hrs.
7	Max. discharge of record	179 cfs July 1993	342 cfs October 1973	334 cfs July 1993	190 cfs October 1973	148 cfs October 1973	185 cfs March 1967	166 cfs June 1983	418 cfs March 1967	187 cfs June 1983	774 cfs July 1993
8	Max. pool elevation of record	1342.62 July 1993	1318.5 October 1973	1295.4 October 1973	1279.0 October 1973	1252.3 October 1973	1241.1 March 1967	1348.9 June 1983	1249.9 July 1993	1249.97 July 1993	1287.9 August 1987
9	Project cost	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	DAM AND EMBANKMENT										
9	Top of dam - ft. MSL	1359.0	1334.0	1312.8	1284.8	1270.8	1266.0	1364.8	1271.8	1273.0	1320.0
10	Length of dam - ft	3020.0	2480.0	1830.0	2250.0	3160.0	3000.0	2075.0	5000.0	2700.0	5200.0
11	Height of dam - ft.	45.0	57.0	52.0	44.0	52.0	53.0	58.0	65.0	55.0	78.0
12	Stream bed - ft. MSL	1314.0	1277.0	1280.0	1246.0	1218.0	1197.0	1306.8	1206.0	1218.0	1250.0
13	Abutment formation	Clay - sand - silt	Clay - sand	Clay	Clay - sand	Clay - sand	Clay - silt	Clay - sand - silt	Clay - sand	Clay - sand	Clay - sand - silt
14	Type of fill	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth
15	Fill quantity in cu. yds.	312,000	471,000	378,000	374,000	502,000	658,000	815,000	870,000	900,000	248,000
16	Date of closure	20 Sept. 1963	12 Sept. 1962	24 Sept. 1962	27 Aug. 1963	5 Oct. 1965	24 Sept. 1963	26 Sept. 1965	18 Jul. 1964	17 Sept. 1962	21 Aug. 1967
17	Date of initial fill	30 Jun. 1965	6 Jul. 1963	24 Jun. 1963	25 May 1965	10 Jun. 1967	May 1965	16 Mar. 1969	21 Jun. 1967	2 Jun. 1965	18 Jan. 1973
	SPILLWAY										
18	Discharge capacity - cfs	15,875 at el. 1357.1	22,925 at el. 1331.7	23,210 at el. 1309.8	17,965 at el. 1281.6	12,100 at el. 1267.6	27,220 at el. 1256.2	25,200 at el. 1361.6	19,875 at el. 1269.1	800 at el. 1269.7	7,825 at el. 1317.5
19	Crest elevation - ft. MSL	1350.0	1322.5	1302.0	1285.0	1262.0	1252.0	1353.0	1263.5	1256.0	1311.0
20	Width - ft.	340.0	340.0	430.0	430.0	400.0	750.0	400.0	700.0	50.0	260.0
21	Gates: number, size, type	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel
	RESERVOIR ELEVATION AND AREA										
22	Maximum pool	1357.1 470A	1331.7 988A	1309.8 675A	1291.8 648A	1267.8 624A	1256.2 755A	1361.6 845A	1269.1 1472A	1269.7 437A	1317.3 4207A
23	Top of flood control pool	1350.0 355A	1322.5 845A	1302.0 880A	1285.0 488A	1262.0 464A	1252.0 620A	1353.0 905A	1263.5 1408A	1256.0 391A	1311.0 3646A
24	Top of joint use pool	none	none	none	none	none	none	none	none	none	none
25	Top of conservation pool	1335.0 174A	1307.4 308A	1287.8 303A	1271.1 188A	1244.9 284A	1232.8 230A	1341.0 255A	1244.3 737A	1242.4 123A	1284.0 1780A
26	Top of sediment pool	1335.0 174A	1308.1 284A	1284.8 225A	1271.1 188A	1241.9 178A	1232.8 230A	1337.4 208A	1244.3 737A	1240.0 102A	1275.7 1270A
	STORAGE ZONES (Elev. - Capacity)										
27	Surcharge zone	1350.0 - 1357.1 2,810AF	1322.5 - 1331.7 7,215AF	1302.0 - 1309.8 5,990AF	1285.0 - 1291.8 3,725AF	1262.0 - 1267.8 3,242AF	1252.0 - 1256.2 4,245AF	1353.0 - 1361.6 3,790AF	1263.5 - 1269.1 8,993AF	1256.0 - 1269.7 1,534AF	1311.0 - 1317.3 24,720AF
28	Excursions flood control zone	1335.0 - 1350.0 3,960AF	1307.4 - 1322.5 7,113AF	1287.8 - 1302.0 6,780AF	1271.1 - 1285.0 4,700AF	1244.9 - 1262.0 5,654AF	1232.8 - 1252.0 8,030AF	1341.0 - 1353.0 5,290AF	1244.3 - 1263.5 20,290AF	1242.4 - 1256.0 5,885AF	1284.0 - 1311.0 21,570AF
29	Joint use zone	none	none	none	none	none	none	none	none	none	none
30	Conservation zone	none	1308.1 - 1307.4 366AF	1284.8 - 1287.8 630AF	none	1241.8 - 1244.9 993AF	1241.8 - 1244.9 993AF	1337.4 - 1341.0 810AF	none	1240.0 - 1242.4 273AF	1275.7 - 1284.0 13,740AF
31	Sediment pool zone	1314.0 - 1335.0 1,480AF	1277.8 - 1305.1 2,295AF	1280.0 - 1284.8 1,080AF	1268.0 - 1271.1 1,840AF	1218.0 - 1241.8 1,116AF	1197.0 - 1232.8 2,810AF	1308.0 - 1337.4 2,020AF	1308.0 - 1244.3 7,828AF	1216.0 - 1240.0 632AF	1250.0 - 1275.7 13,200AF
32	Gross Storage (Excl of surcharge)	8,470AF	9,794AF	9,290AF	8,940AF	7,583AF	10,840AF	8,090AF	28,118AF	8,790AF	97,590AF
	OUTLET WORKS										
33	Number and size - conduits	1 - CMP - 48" Dia. With 30" RCP lining 290	1 - CMP - 90" Dia. With 42" RCP lining 313	1 - CMP - 60" Dia. With 42" RCP lining 299	1 - CMP - 48" Dia. With 36" RCP lining 280	1 - CMP - 42" Dia. With 30" RCP lining 308	1 - CMP - 60" Dia. With 42" RCP lining 318	1 - CMP - 42" Dia. With 30" RCP lining 335	1 - CMP - 60" Dia. With 42" RCP lining 382	1 - CMP - 60" Dia. With 42" RCP lining 326	1 - CMP - concrete Lined - 72" Dia. 319
34	Conduit length - ft.	1 - 36" x 36" Lift gate- 1330.0	1 - 36" x 36" Lift gate- 1303.0	1 - 36" x 36" Lift gate- 1263.5	1 - 36" x 36" Lift gate- 1261.0	1 - 36" x 36" Lift gate- 1237.0	1 - 36" x 36" Lift gate- 1226.0	1 - 42" x 54" Lift gate- 1333.0	1 - 42" x 60" Lift gate- 1236.0	1 - 36" x 36" Lift gate- 1239.0	1 - 48" x 72" Lift gate - 1274.0
35	Gated outlets (No. - size - type - invert, elev.)	3 - 24" x 72" - 1340.9	2 - 30" x 96" - 1313.5	2 - 36" x 96" - 1282.4	2 - 24" x 72" - 1277.1	2 - 18" x 63" - 1250.0	2 - 30" x 96" - 1242.3	2 - 24" x 63" - 1341.0	2 - 34" x 120" - 1244.3	2 - 36" x 96" - 1249.0	1 - 10' Dia. slide gate- 1278.3
36	Ungated outlets (Openings - size - elev.)	2 - 12" x 54" - 1335.0	2 - 12" x 54" - 1307.4	2 - 12" x 54" - 1287.8	2 - 12" x 30" - 1271.1	2 - 12" x 30" - 1244.9	2 - 12" x 54" - 1232.9	-	-	2 - 12" x 36" - 1242.5	2 - 42" x 144" - 1293.95
37	Orsch. capacity - cfs (At base of EFC zone)	80	75	75	60	95	80	145	210	60	300
38	**POWER INSTALLATION**	none	none	none	none	none	none	none	none	none	none

(1) Total project financial cost including all dams = $12,075,000 (Costs are as of 9-30-90)

January 1995

PLATE 3

SUMMARY OF ENGINEERING DATA - FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL
MISSOURI RIVER TRIBUTARIES - U.S. ENGINEER DISTRICT - OMAHA
CORPS OF ENGINEERS DAMS - PAPILLION CREEK BASIN, NEBRASKA; SOUTH DAKOTA

ITEM NO	SUBJECT	DAM NO. 11 (Glenn Cunningham Lake)	DAM NO. 16 (Standing Bear Lake)	DAM NO. 18 (Zorinsky Lake)	DAM NO. 20 (Wehrspann Lake)	CEDAR CANYON	COLD BROOK	COTTONWOOD SPRINGS	SPRING CREEK LAKE POCASSE		
	GENERAL										
1	Location of dam	93rd State Street	132nd and Fort Street	156th and "F" Street	156th and Giles Road	3.5 mi W of Rapid City, SD	1 mi N of Hot Springs, SD	4.5 mi W of Hot Springs, SD	Pollock, SD		
2	River and mileage	Knight Creek -	Tributary Big Papio -	Bozeman Creek -	Trib. South Branch Papio-	Deadman's Gulch	Cold Brook R M 1	Cottonwood Springs Creek	Spring Creek		
3	Drainage area in square miles	17.8	6	16.6	13.1	0.4	70.6	26	660		
4	Reservoir length in miles	2.8	1.0	1.5	1.8	Normally dry	1.2 at elevation 3648.5	0.6 mi at elevation 3675			
5	Location of Dam/encroach	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Missouri River Project Office	Dams Dam	On site	At Cold Brook Dam	Dams Dam		
6	Travel time to Missouri River	5 - 10 Hours	5 - 10 Hours	5 - 10 Hours	5 - 10 Hours	-	-	-	-		
7	Max. discharge of record	-	-	-	-	440 cfs August 1948	6,400 cfs September 1938	-	-		
8	Project cost (1)	$11,800,000	$4,500,000	$20,856,000	$14,934,000	$122,900	$1,571,800	$2,885,000			
	DAM AND EMBANKMENT										
9	Top of dam - ft. MSL	1152	1139.0	1143.5	1131	3554.6	3675.0	3953.0	1625.6		
10	Length of dam - ft	1848	1468	1400	1810	1,320	925	1,190	3,200		
11	Height of dam - ft.	67	70	64	58	42	127	123	40		
12	Stream bed - ft. MSL	1085	1068	1079.5	1080	3,512	3,548	3,832	1,585		
13	Abutment formation	Loess clay loess	Loess clay loess	Loess clay loess	Loess clay loess	Minnekahta limestone	Sandstone, shale, limestone	Minnekahta limestone			
14	Type of fill	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth		
15	Fill quantity in cu. yds.	856,000	481,000	1,203,000	767,450	150,000	1,872,000	960,000			
16	Date of closure	6 Aug 1974	3 Oct 1972	15 July 1964	21 Sep 1962	September 1958	September 1952	May 1969	1961		
17	Date of initial fill	2 Sep 1977	24 Oct 1977	-	29 May 1967	-	June 1983 (3564.7)	-	Between 1961 and 1964		
	SPILLWAY										
18	Discharge capacity - cfs (max. pool)	18,700	8,500	30,000	12,000	1,480 cfs at elevation 3550.6	80,600 cfs at el. 3667.2	39,800 cfs at el.3950.3			
19	Crest elevation - ft MSL	1142	1121	1126.2	1120	3545.0	3648.5	3936.0	1617.0		
20	Width - ft.	700	250	400	600	60	200	275	72		
21	Gates, number, size, type	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated earth channel	Ungated rock channel	Ungated sharp crested weir	Ungated broad weir	Ungated box culverts		
	RESERVOIR ELEVATION AND AREA										
22	Maximum pool	1147 1170A	1127 368A	1136.2 480A	1125.8 805A	3550.6 15A	3667.2 270A	3950.0 257A	1625.0 2,568A		
23	Top of flood control pool	1142 961A	1121 302A	1126.2 594A	1113.1 465A	3545.0 11A	3651.4 198A	3936.0 214A	-		
24	Top of multipurpose pool	1121 377A	1104 137A	1110.0 283A	1095.83 (2) 239A	none	3585.0 39A	3875.0 41A	1617.0 1,529A		
25	Top of inactive pool					3526.0 2A	none	3868.0 30A	1602.0 60A		
	STORAGE ZONES (Elev. - Capacity)										
26	Surcharge	1142 - 1147 9,465AF	1127 - 1127 2,810AF	1126.2 - 1134.2 7,225AF	1113.1 - 1125.8 6,128AF	3545.0 - 3550.6 74AF	3651.4 - 3667.2 3,800AF	3936.0 - 3950.0 3,250AF	1617.0 - 1625.0 15,000AF		
27	Flood control	1121 - 1142 13,869AF	1104 - 1121 3,720AF	1110.0 - 1126.2 7,585AF	1095.83 - 1113.1 6,119AF	3526.0 - 3545.0 123AF	3585.0 - 3651.4 6,880AF	3875.0 - 3936.0 7,730AF			
28	Multipurpose	1065 - 1121 3,262AF	1060 - 1104 1,580AF	1088.5 - 1110.0 3,470AF	1089 - 1095.83 2,682AF	none	3548.0 - 3585.0 520AF	3868.0 - 3875.0 248AF	1585.0 - 1617.0 11,000AF		
29	Inactive					3512.0 - 3526.0 13AF	none	3832.0 - 3868.0 408AF			
30	Gross Storage (Excl of surcharge)	17,181AF	5,220AF	11,055AF	8,801AF	136AF	7,200AF	8,585AF	11,000AF		
	OUTLET WORKS										
31	Number and size - conduits	1 - RCP - 54" Dia	1 - RCP - 36" Dia	1 - RCP - 48" Dia	1 - RCP - 48" Dia	1 - 24 in. C. M. P	1 - 8.67 ft. conduit	1 - 48 in. concrete	1 - 8 ft. CMP		
							1 - 8 in. supply line				
32	Conduit length - ft.	660	738	782	656	230	907	580			
33	Disch. capacity of conduit - cfs(at top of FC Pool)	570	160	480	490	49 cfs at el. 3545	1548 cfs at el. 3651.4	540 cfs at el. 3936.0			
34	Gated outlets (No - size - invert elev. of intake)	1 - 36" x 36" 1,100	1 - 24" x 36" 1,085.0	1 - 30" x 30" 1,090.0	1 - 30" x 30" Dia 1,077.0	Ungated inlet - el. 3526	Ungated drop inlet - el. 3585	Ungated drop inlet - el. 3875	5 x 5 ft sluice gate at 1602		
				1 - 6" diameter 1,104.25	1 - 6" diameter 1,090.0		3 - 12 in. gate valves at 3548	1 - 3 x 3 ft. gate - el. 3868	5 x 12 ft overflow roller		
							1 - 8 in. valve		gate at 1609		
35	Disch. capacity of gated outlets - cfs	90	90	140	140						
36	Ungated outlets (No - size - invert elev. -ft. MSL)	2 - 2.0' x 4.0' 1,121	2 - 1.0' x 2.5' 1,104.0	2 - 1.5' x 3.5' 1,119.0	2 - 1.25' x 3.5' 1,095.83						
		2 - 2.5' x 5.0' 1,127.5	2 - 2.0' x 6.0' 1,089.0	2 - 3.15' x 8.0' 1,117.8	2 - 3.67' x 6.0' 1,103.4						
37	POWER INSTALLATION	none	none	none	none	none	none	none	none		

(1) Cost as of 6-30-84

(2) Based on a survey of July 1987 the elevation of the overflow lip was changed from 1096.0 ft MSL to 1095.83 ft MSL

January 1989

PLATE 4

SUMMARY OF ENGINEERING DATA - FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL
MISSOURI RIVER TRIBUTARIES - U.S. ENGINEER DISTRICT - OMAHA
BUREAU OF RECLAMATION DAMS

ITEM NO	SUBJECT	BOYSEN	CANYON FERRY	CLARK CANYON	GLENDO	HEART BUTTE	JAMESTOWN	KEYHOLE	PACTOLA	SHADEHILL	TIBER	YELLOWTAIL
	GENERAL											
1	Location of dam	20 mi S of Thermopolis Wy	17 mi NE of Helena, MT	18 mi SW of Dillon, MT	4.5 mi SE of Glendo WY	15 mi S of Glen Ullin, ND	1 mi N of Jamestown, ND	12 mi NE of Moorcroft, WY	15 mi W of Rapid City SD	1 mi W of Shadehill, SD	15 mi SW of Chester, MT	45 mi SW of Hardin MT
2	River and river mile	Wind RM 295	Missouri RM 2253	Beaverhead	North Platte RM 280	Heart RM 103.5	James RM 590	Belle Fourche RM 289	Rapid Cr RM 110	Grand RM 90	Marias RM 71	Bighorn
3	Drainage area (sq mi)	7710	15900	2329	14330	1710	1300	1956	319	3120	4650	19 826
4	Reservoir length (mi)	17.5 at el 4725	25 at el 3800	5 at el 5560.4	18 at el 4635	12 at el. 2094.5	40 at el. 1454	10 at el. 4111.4	4.5 at el 4621.5	18 at el 2302	25 at el 3012.5	71 at el 3657
5	Location of Dam/dike	On site	On site	Dillon, MT	On site	On site	none	Pactola Dam	On site	none	On site	On site
6	Travel time to Missouri River	6 days	4.5 days to Ft. Peck	2.5 days to Three Forks	About 3 weeks	2 days	About 7 weeks	5 days	3 days	2 days	1.25 days	4 days
7	Max. discharge of record	29 600 cfs Jul 1923	47,000 cfs Jun 1908	3720 cfs Jun 1908	30 000 cfs Jun 1908	30 500 cfs May 1970	± 6000 cfs Apr 1969	12 000 cfs Apr 1924	2200 cfs May 1952	58 000 cfs Apr 1953	40,000 cfs Jun 1948	37 400 cfs Jun 1935
8	Project cost (1)	$33 468 000	$42 548 000	$12 106 000	$44,371 000	$3 578 000	$3,717 000	$4 723 000	$7,861 000	$7 298 000	$44 906 000 (1983)	$95 800 000
	DAM AND EMBANKMENT											
9	Top of dam - ft. MSL	4758.0	3808.5	5578.0	4675.0	2124.0	1471.0	4134.0	4656.0 (3)	2318.0	3028.0	3660.0
10	Length of dam - ft	1143	1800	2950	2000	1850	1418	3420	5290	12,840	4300	1450
11	Height of dam - ft.	150	225	147.5	147	124	85	116	245	122	201	324
12	Stream bed - ft. MSL	4608	3635.5	5448.5	4568	2000	1386	4018	4422	2198	2823.5	3168
13	Abutment formation	Sandstone-shale-limestone	Shale - slate	Sand - bentonitic fill	Sandstone - shale	Sandstone	Pierre shale	Sandstone and shale	Slate and schist	Sand, silt and clay	Shale and sandstone	Limestone
14	Type of fill	Rolled earth	Concrete gravity	Rolled earth	Rolled earth	Rolled earth	Rolled earth	Rolled earth and rock	Rolled earth and rock	Rolled earth	Rolled earth	Concrete thin-arch
15	Fill quantity in cu. yds	1,527,000	407,100	1,884,000	2,676,000	1,140,000	983,000	1,329,000	4,532,000	3,381,000	12,049,000	1 548 000
16	Date of closure	Oct 1951	Mar 1953	Aug 1964	Jun 1956	Aug 1949	May 1953	Mar 1952	Aug 1956	Jul 1950	Oct 1950	Dec 1968
17	Date of initial fill (top of conser. pool)	Jun 1952	Jul 1955	Jun 1965	May 1959	Apr 1950	Apr 1965	May 1976	Jun 1963	Apr 1952	Aug 1956	Jun 1967
	SPILLWAY											
18	Discharge capacity - cfs (Max. pool)	20 000 at el 4725	150 000	9530	10 300	5850	2930	11000	255,000	(Service) 5700 127 000 cfs	88 475	92000
19	Crest elevation - ft. MSL	4700.0	3786.0	5560.4	4653.0	2084.5	1454	4098.3	4621.5	2271.9 2302.0	2975.0	3593.0
20	Width - ft.	60 (net) 68 (total)	204 (net) 222 (gross)	100	45	27	9.5	19.28	425	- 1500	66	50 (net)
21	Gates: number, size, type	2 (36 x 25 ft radial	4 (51 x 34.5 ft radial	Ungated chute	Ungated ogee weir	Ungated glory hole	Ungated glory hole	Ungated ogee weir	Ungated ogee weir	Ungated glory hole Ungated earth channel	3 - 22 x 38 ft radial	2 - 25 x 64.4 ft. radial
	RESERVOIR ELEVATION AND AREA											
22	Maximum pool	4752.0 30 660a	3800.0 33,535a	5571.9 6500a	4689.0 21,380a	2118.2 10,950a	1464.4 17,430a	4128.7 10,730a	4651.7 1,560a	2312.0 12,150a	3028.2 25,410a	3660.0 57,940a
23	Top of flood control pool	4732.2 22,170a	3800.0 33,535a	5560.4 5900a	4653.0 17,990a	2094.5 6,580a	1454.0 13,210a	4111.5 13,730a	4621.5 1,230a	2302.0 9,900a	3012.5 23,150a	3657.0 57,280a
24	Top of joint use pool	4725.0 19,560a	3797.0 32,800a	5546.1 5160a			1432.67 2,580a				2993.0 17,690a	3640.0 52,600a
25	Top of conservation pool	4717.0 18,960a	3775.0 24,125a	5535.7 4495a	4635.0 12,370a	2084.5 3,400a	1429.8 2,080a	4098.3 9,410a	4621.5 990a	2271.9 4,800a	2978.0 13,790a	3614.0 6,815a
26	Top of inactive pool	4665.0 9,280a	3728.0 11,480a	5470.6 220a	4578.0 3,130a	2030.0 800a	1408.0 160a	4051.0 820a	4456.1 100a	2250.8 2,900a	2966.4 11,710a	3567.0 4,150a
	STORAGE ZONES (Elev. - Capacity)											
27	Surcharge zone	4732.2-4752.0 820,700AF	none	5560.4-5571.0 71,636AF	4653.0-4689.0 329,300AF	2094.5-2118.2 208,400AF	1454.0-1464.4 158,900AF	4111.5-4128.7 294,800AF	4621.5-4651.7 41,892AF	2302.0-2312.0 111,200AF	3012.5-3028.2 187,740AF	3657.0-3660.0 82,830AF
28	Exclusive flood control zone	4725.0-4732.2 150,400AF	3797.0-3800.0 99,460AF	5546.1-5560.4 78,680AF	4635.0-4653.0 271,900AF	2084.5-2094.5 147,900AF	1432.7-1454.0 185,400AF	4098.3-4111.5 140,500AF	4580.2-4621.5 43,057AF	2271.9-2302.0 218,300AF	2993.0-3012.5 400,900AF	3640.0-3657.0 258,330AF
29	Joint use zone	4717.0-4725.0 148,160AF	3770.0-3797.0 795,136AF	5535.7-5546.1 50,440AF	none	none	1429.8-1432.7 6,000AF	none	none	none	2978.0-2993.0 268,000AF	3614.0-3640.0 240,940AF
30	Conservation zone	4665.0-4717.0 403,800AF	3728.0-3770.0 711,480AF	5470.6-5535.7 126,120AF	4578.0-4635.0 454,300AF	2030.0-2084.5 69,000AF	1408.0-1429.8 28,160AF	4051.0-4098.3 185,500AF	4456.1-4580.2 54,955AF	2250.8-2271.9 60,900AF	2966.4-2978.0 121,700AF	3567.0-3614.0 336,100AF
31	Inactive zone	4608.0-4665.0 282,100AF	3635.5-3728.0 445,488AF	5448.5-5470.6 1,510AF	4568.0-4578.0 83,200AF	2000.0-2030.0 6,000AF	1386.0-1408.0 820AF	4018.0-4051.0 8,000AF	4422.0-4456.1 1,617AF	2198.0-2250.8 56,208AF	2823.5-2966.4 577,620AF	3168.0-3567.0 493,580AF
32	Gross Storage (Excl. of surcharge)	852,400AF	2,051,520AF	257,150AF	789,400AF	223,800AF	224,600AF	334,200AF	99,029AF	387,400AF	1,555,360AF	1,328,380AF
	OUTLET WORKS											
33	Number and size - conduits	1 - 66 in. I.D. 1 - 97 in. I.D.	4 - 84 in. I.D. 1 - 13 ft. I.D. penst. intake	1 - 9 ft. I.D.	1 - 21 ft. I.D.	1 - 63 in. I.D.	1 - 9.5 ft. - 13.5 ft.	1 - 9.5 x 6.25	1 - 8 ft.	1 - 7 ft. I.D.	1 conduit containing 1 - 72", 1 - 22" pipes	2 - 84 in. 1 - 9.5 ft.
34	Conduit length - ft.	300	84 in. - 115	741	2300	987	443.75	653.4	740	555	72" - 1110 22"-1090	289 - 216 - 306
35	Number - size - type gates	2 - 48 in. Jet valves	4 - 77 in. Slide 9500	2 - 3 x 6.5 ft. Slide	3 - 7.25 x 7.75 ft. Slide	1 - 4 x 5 ft. Slide	2 - 5 x 8 ft. Slide	2 - 3.5 x 3.5 ft. Slide	2 - 2.75 x 2.75 ft. Slide	1 - 6 x 5 ft. radial	1-5x8 Slide, 1-16" butterfly	3 - bulkhead gates
36	Disch. capac. - cfs (At base of EFC zone)	66 in. - 840 97 in. - 870	1 - 13 ft. dia. 8000 3 - 13.5 ft. dia. 3970	2200	11,300	690	2175 at el. 1429.8	1250	1020	800 at el. 2290	1425 at el. 2993 Aux. outlet see footnote (2)	94 in. - 2300 each 9.5 ft. - 862
	POWER INSTALLATION											
37	No. and size of turbines	2 - 16,500 HP	3 - 23,300 HP	none	2 - 18,750 HP	none	none	none	none	none	none	4 - 87,500 HP
38	No. and rating of generators	2 - 7500 KW	3 - 16,667 KW		2 - 12,000 KW							4 - 52,500 KW
39	Plant capacity	15,000 KW	50 000 KW		24,000 KW							250 000 KW
40	Power Plant disch. capac. (At base of EFC)	5200 cfs	5200 cfs		3300 cfs							7900 cfs

(1) These costs to complete the dam and reservoir, the associated recreation and fish and wildlife facilities and the power plant are applicable. Costs do not include irrigation facilities except those located at the dam. Costs are as of 6-30-76.

January 1995

(2) TIBER AUXILIARY OUTLET

No. and size of conduits	1 - 10.75 ft. I.D.
Conduit length - ft.	1535
No. - Size - Type gates	1 - 7.25 x 9.25 ft. slide 2 - 7.0 x 12.0 ft. slide
Discharge capacity - cfs	4250 at el. 3020.2

(3) Pactola Dam was re-sea 15 feet in 1987.

PLATE 5

SUMMARY OF ENGINEERING DATA — MISSOURI RIVER MAINSTEM RESERVOIRS

ITEM NO	SUBJECT	FORT PECK LAKE	GARRISON DAM — LAKE SAKAKAWEA	OAHE DAM — LAKE OAHE	BIG BEND DAM — LAKE SHARPE	FORT RANDALL DAM — LAKE FRANCIS CASE	GAVINS POINT DAM — LEWIS & CLARK LAKE	TOTAL	ITEM NO.
1	Location of dam	Near Glasgow, Mont	Near Garrison, N.D.	Near Pierre, S.D.	21 mi upstream Chamberlain, S.D.	Near Lake Andes, S.D.	Near Yankton, S.D.		1
2	River Mile - 1960 mileage	Mile 1771.5	Mile 1389.9	Mile 1072.3	Mile 987.4	Mile 880.0	Mile 811.1		2
3	Total & incremental drainage areas in square miles	57,500	181,400 (2) 123,900	243,490 (1) 62,090	249,330 (1) 5,840	263,480 (1) 14,150	279,480 (1) 16,000		3
4	Approximate length of full reservoir (in valley miles)	134, ending near Zortman, Mont	178, ending near Trenton, N.D.	231, ending near Bismarck, N.D.	80, ending near Pierre, S.D.	107, ending at Big Bend Dam	25, ending near Niobrara, Nebr	755 miles	4
5	Shoreline in miles (3)	1520 (El 2234)	1340 (El 1837.5)	2250 (El 1607.5)	200 (El 1420)	540 (El 1350)	90 (El 1204.5)	5,940 miles	5
6	Average total & incremental inflow in cfs	10,200	25,600 15,400	28,900 3,300	28,900	30,000 1,100	32,000 2,000		6
7	Max. discharge of record near damsite in cfs	137,000 (June 1953)	348,000 (April 1952)	440,000 (April 1952)	440,000 (April 1952)	447,000 (April 1952)	480,000 (April 1952)		7
8	Construction started - cal. yr.	1933	1946	1948	1959	1946	1952		8
9	In operation (4) cal. yr.	1940	1955	1962	1964	1953	1955		9
	DAM AND EMBANKMENT								
10	Top of dam, elev. ft. msl	2280.5	1875	1660	1440	1395	1234		10
11	Length of dam in feet	21,026 (excluding spillway)	11,300 (including spillway)	9,300 (excluding spillway)	10,570 (including spillway)	10,700 (including spillway)	8,700 (including spillway)	71,596	11
12	Damming height, feet (5)	220	180	200	78	140	45	863 feet	12
13	Maximum height, feet (5)	250.5	210	245	95	165	74		13
14	Max. base width, total & w/o berms, feet	3500, 2700	3400, 2050	3500, 1500	1200, 700	4300, 1250	850, 450		14
15	Abutment formations (under dam & embankment)	Bearpaw shale and glacial fill	Fort Union clay shale	Pierre shale	Pierre shale & Niobrara chalk	Niobrara chalk	Niobrara chalk & Carlile shale		15
16	Type of fill	Hydraulic & rolled earth fill	Rolled earth fill	Rolled earth fill & shale berms	Rolled earth, shale, chalk fill	Rolled earth fill & chalk berms	Rolled earth & chalk fill		16
17	Fill quantity, cu. yds.	125,628,000	66,500,000	55,000,000 & 37,000,000	17,000,000	28,000,000 & 22,000,000	7,000,000	358,128,000 cu. yds.	17
18	Volume of concrete (cu. yds.)	1,200,000	1,500,000	1,045,000	540,000	961,000	308,000	5,554,000 cu. yds.	18
19	Date of closure	24 June 1937	15 April 1953	3 August 1958	24 July 1963	20 July 1952	31 July 1955		19
	SPILLWAY DATA								
20	Location	Right bank - remote	Left bank - adjacent	Right bank - remote	Left bank - adjacent	Left bank - adjacent	Right bank - adjacent		20
21	Crest elevation, msl	2225	1825	1596.5	1385	1346	1180		21
22	Width (including piers) in feet	820 gated	1336 gated	456 gated	376 gated	1000 gated	664 gated		22
23	No., size and type of gates	16 - 40'x25' Vertical Lift Gates	28 - 40'x29' Tainter	8 - 50'x23.5' Tainter	8 - 40'x38' Tainter	21 - 40'x29' Tainter	14 - 40'x30' Tainter		23
24	Design discharge capacity, cfs	275,000 at elev 2253.3	827,000 at elev 1858.5	304,000 at elev 1644.4	390,000 at elev 1433.6	620,000 at elev 1379.3	584,000 at elev 1221.4		24
25	Discharge capacity at maximum operating pool, cfs	230,000	660,000	80,000	270,000	508,000	345,000		25
	RESERVOIR DATA (6)								
26	Max. operating pool elev. & area	2250 msl 246,000 acres	1854 msl 380,000 acres	1620 msl 374,000 acres	1423 msl 61,000 acres	1375 msl 102,000 acres	1210 msl 31,000 acres	1,194,000 acres	26
27	Max. normal op. pool elev. & area	2246 msl 240,000 acres	1850 msl 364,000 acres	1617 msl 360,000 acres	1422 msl 60,000 acres	1365 msl 95,000 acres	1208 msl 28,000 acres	1,147,000 acres	27
28	Base flood control elev. & area	2234 msl 212,000 acres	1837.5 msl 307,000 acres	1607.5 msl 312,000 acres	1420 msl 57,000 acres	1350 msl 77,000 acres	1204.5 msl 25,000 acres	990,000 acres	28
29	Min. oper. pool elev. & area; Storage allocation elev. & cap.	2160 msl 90,000 acres	1775 msl 128,000 acres	1540 msl 117,000 acres	1415 msl 51,000 acres	1320 msl 40,000 acres	1204.5 msl 25,000 acres	451,000 acres	29
30	Exclusive flood control	2250-2246 975,000 a.f.	1854-1850 1,489,000 a.f.	1620-1617 1,102,000 a.f.	1423-1422 60,000 a.f.	1375-1365 986,000 a.f.	1210-1208 60,000 a.f.	4,672,000 a.f.	30
31	Flood control & multiple use	2246-2234 2,717,000 a.f.	1850-1837.5 4,222,000 a.f.	1617-1607.5 3,201,000 a.f.	1422-1420 117,000 a.f.	1365-1350 1,315,000 a.f.	1208-1204.5 92,000 a.f.	11,664,000 a.f.	31
32	Carryover multiple use	2234-2160 10,785,000 a.f.	1837.5-1775 13,130,000 a.f.	1607.5-1540 13,461,000 a.f.		1350-1320 1,640,000 a.f.		39,024,000 a.f.	32
33	Permanent	2160-2030 4,211,000 a.f.	1775-1673 4,980,000 a.f.	1540-1415 5,373,000 a.f.	1420-1345 1,682,000 a.f.	1320-1240 1,546,000 a.f.	1204.5-1160 340,000 a.f.	18,131,000 a.f.	33
34	Gross	2250-2030 18,688,000 a.f.	1854-1673 23,821,000 a.f.	1620-1415 23,137,000 a.f.	1423-1345 1,859,000 a.f.	1375-1240 6,484,000 a.f.	1210-1160 492,000 a.f.	73,491,000 a.f.	34
35	Reservoir filling initiated	November 1937	December 1953	August 1958	November 1963	January 1953	August 1955		35
36	Initially reached min. oper. pool	27 May 1942	7 August 1955	3 April 1962	25 March 1964	24 November 1953	22 December 1955		36
37	Est. annual sediment inflow	18,100 a.f. 1030 yrs	25,900 a.f. 920 yrs	19,600 a.f. 1170 yrs	4,300 a.f. 430 yrs	21,000 a.f. 260 yrs	2,600 a.f. 180 yrs	92,500 a.f.	37
	OUTLET WORKS DATA								
38	Location	Right bank	Right bank	Right bank		Left bank			38
39	Number and size of conduits	2 - 24.7' dia. (Nos. 3 & 4)	1 - 26' dia. and 2 - 22' dia.	6 - 19.75' dia. upstream, 18.25' dia. downstream	None (7)	4 - 22' diameter	None (7)		39
40	Length of conduits in feet (8)	No. 3 - 6,615, No. 4 - 7,240	1529	3496 to 3659		1013			40
41	No., size and type of service gates	1 - 28' dia. cylindrical gate, 6 ports, 7.6' x 8.5' high (net opening) in each control shaft	1 - 18'x24.5' Tainter gate per conduit for fine regulation	1 - 13'x22' per conduit, vertical lift, 4 cable suspension and 2 hydraulic suspension (fine regulation)		2 - 11'x23' per conduit, vertical lift, cable suspension			41
42	Entrance invert elevation (msl)	2095	1672	1425	1385 (12)	1229	1180 (12)		42
43	Avg. discharge cap. per conduit & total	Elev. 2250 22,500 cfs 45,000 cfs	Elev. 1854 30,400 cfs 98,000 cfs	Elev. 1620 18,500 cfs 111,000 cfs		Elev. 1375 32,000 cfs 128,000 cfs			43
44	Present tailwater elev. (msl)	2032-2036 5,000-35,000 cfs	1672-1680 15,000-60,000 cfs	1423-1428 25,000-55,000 cfs	1351-1355(11) 25,000-100,000 cfs	1230-1238 5,000-60,000 cfs	1158-1166 15,000-60,000 cfs		44
	POWER FACILITIES AND DATA								
45	Avg. gross head avail. in ft. (13)	194	161	174	70	117	48	764 feet	45
46	Number and size of conduits	No. 1 - 24.8' dia., No. 2 - 22.4' dia.	5 - 29' dia., 25' penstocks	7 - 24' dia., imbedded penstocks	None, direct intake	8 - 28' dia., 22' penstocks	None, direct intake		46
47	Length of conduits in feet (8)	No. 1 - 5,653, No. 2 - 6,355	1,829	From 3,280 to 4,005		1,074		55,083	47
48	Surge tanks	PH#1: 3-40' dia., PH#2: 2-65' dia.	65' dia., 2 per penstock	70' dia., 2 per penstock	None	59' dia., 2 per alternate penstock	None		48
49	No., type and speed of turbines	5 Francis, PH#1 2-128.5, 1-164 RPM, PH#2 2-128.6 rpm	5 Francis, 90 rpm	7 Francis, 100 rpm	8 Fixed blade, 81.8 rpm	8 Francis, 85.7 rpm	3 Kaplan, 75 rpm	36 Units	49
50	Disch. cap. at rated head, cfs	PH#1 units 1 & 3 170', 2 140'; 8,800 cfs PH#2 2-170' 7,200 cfs	150' 38,000 cfs	185' 54,000 cfs	67' 103,000 cfs	112' 44,500 cfs	48' 36,000 cfs		50
51	Gen. nameplate rating, kw	2-43,500, 1-18,250, 2-40,000	3-109,250, 2-95,000	112,290	3-67,276, 5-58,500	40,000	44,100		51
52	Plant capacity, kw	185,250	517,250	786,030	494,320	320,000	132,300	2,435,400 kw	52
53	Dependable capacity, kw (9)	181,000	388,000	534,000	497,000	293,000	74,000	1,967,000 kw	53
54	Average annual energy, million kwh (13)	1,044	2,354	2,694	1,001	1,745	700	9,538 million kwh	54
55	Initial gen., first & last unit	July 1943 - June 1961	January 1956 - October 1960	April 1962 - June 1963	October 1964 - July 1966	March 1954 - January 1956	September 1956 - January 1957	July 1943 - July 1966	55
56	Estimated cost September 1992 Completed project (14)	$158,428,000	$299,938,000	$346,521,000	$107,498,000	$199,066,000	$49,617,000	$1,161,068,000	56

REMARKS

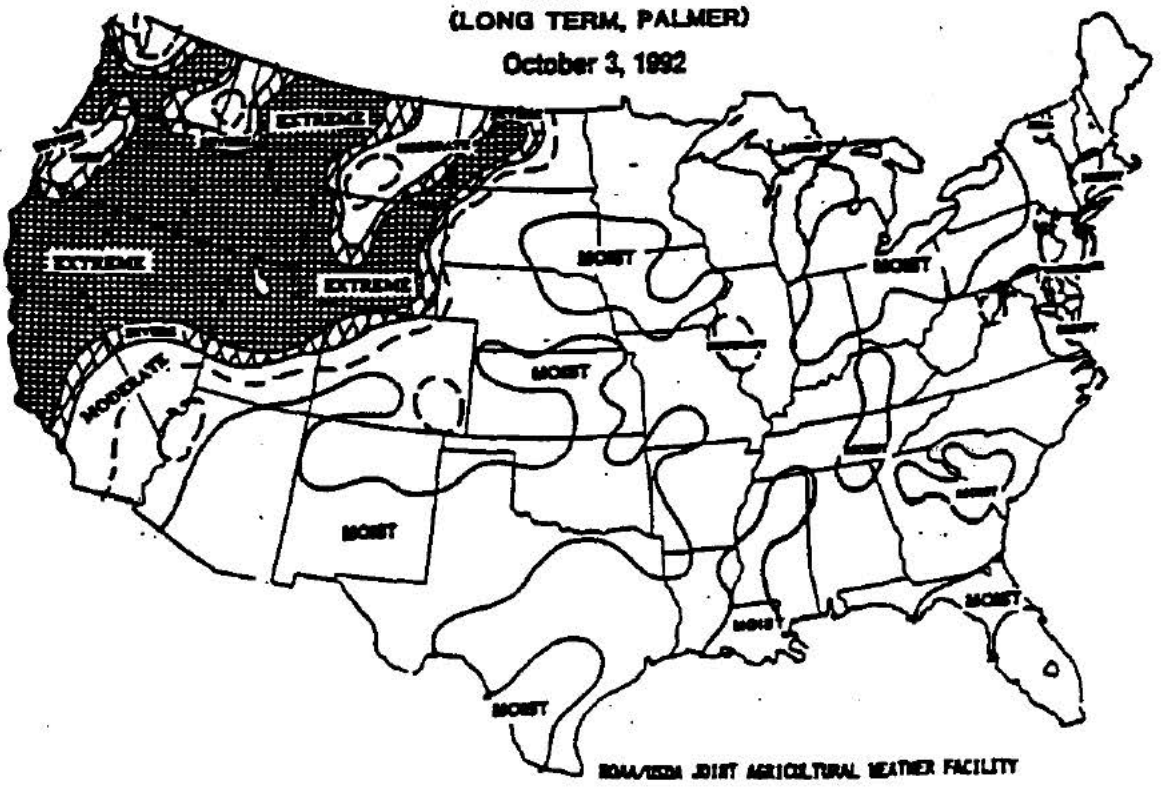
(1) Includes 4,280 square miles of non-contributing areas.
(2) Includes 1,350 square miles of non-contributing areas.
(3) With pool at base of flood control.
(4) Storage first available for regulation of flows.
(5) Damming height is height from low water to maximum operating pool. Maximum height is from average streambed to top of dam.
(6) Based on latest available storage data.
(7) River regulation is attained by flows over low-crested spillway and through turbines.
(8) Length from upstream face of outlet or to spiral case.
(9) Based on 8th year (1961) of drought drawdown (From study 8-83-1985).
(10) Storage volumes are exclusive of Snake Creek arm.
(11) Affected by level of Lake Francis Case. Applicable to pool at elevation 1350.
(12) Spillway crest.
(13) Based on study 8-83-1985.
(14) Source: Annual Report on Civil Works Activities of the Corps of Engineers. Extract Report Fiscal Year 1992.

Corps of Engineers, U.S. Army
Compiled by
Missouri River Division
May 1993

PLATE 6

DROUGHT SEVERITY
(LONG TERM, PALMER)

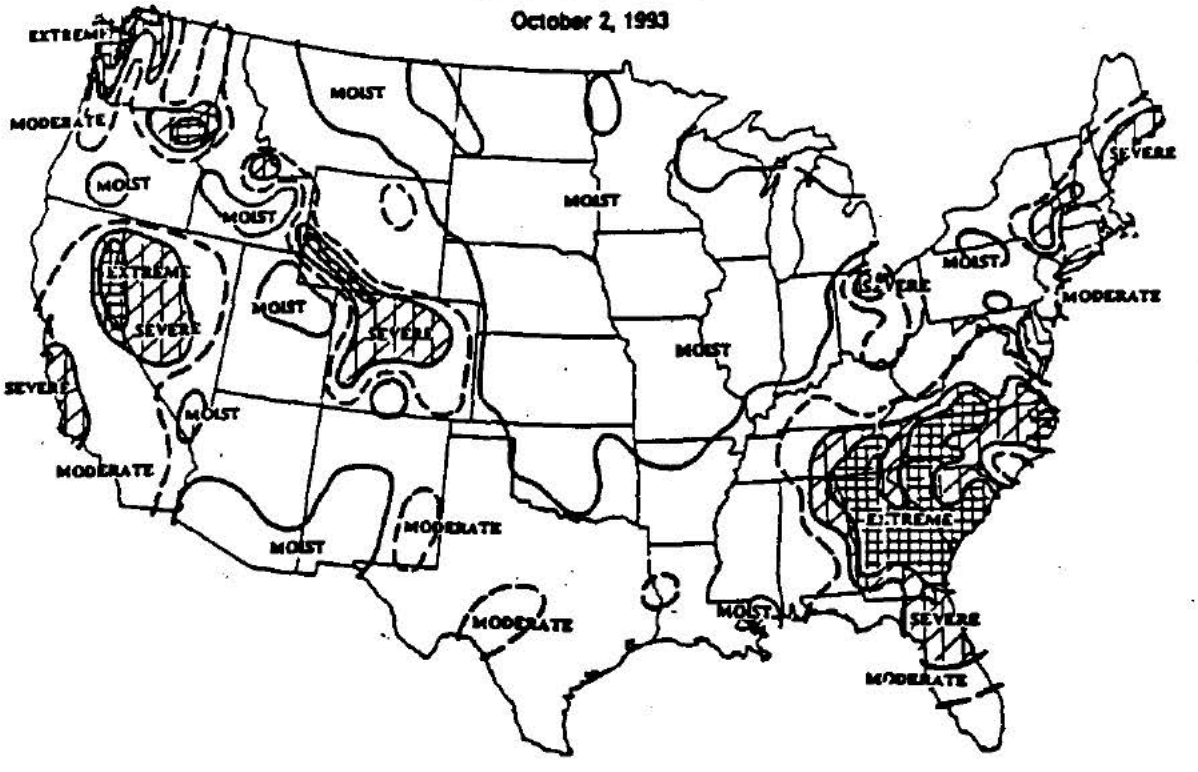
October 3, 1992



NOAA/USDA JOINT AGRICULTURAL WEATHER FACILITY

DROUGHT SEVERITY
(LONG TERM, PALMER)

October 2, 1993

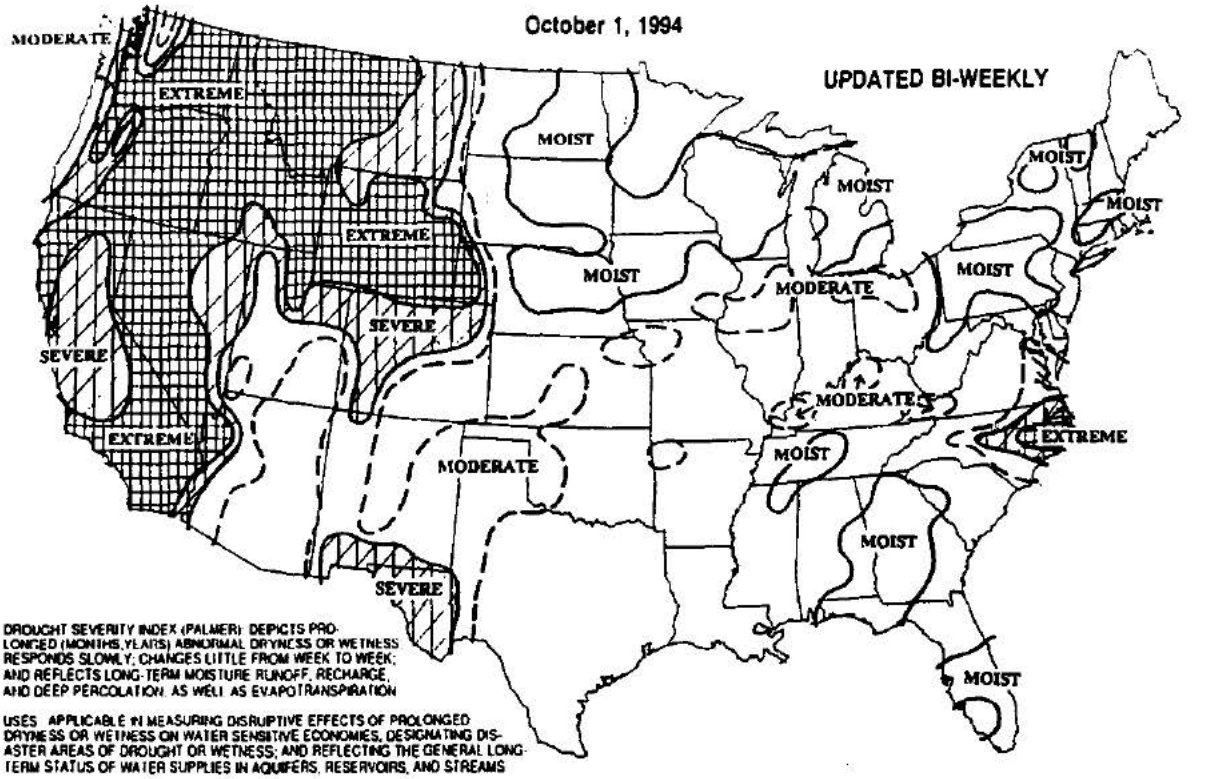


NOAA/USDA JOINT AGRICULTURAL WEATHER FACILITY

PLATE 7

DROUGHT SEVERITY
(LONG TERM, PALMER)

October 1, 1994



DROUGHT SEVERITY INDEX (PALMER): DEPICTS PROLONGED (MONTHS,YEARS) ABNORMAL DRYNESS OR WETNESS. RESPONDS SLOWLY; CHANGES LITTLE FROM WEEK TO WEEK; AND REFLECTS LONG-TERM MOISTURE RUNOFF, RECHARGE, AND DEEP PERCOLATION, AS WELL AS EVAPOTRANSPIRATION.

USES...APPLICABLE IN MEASURING DISRUPTIVE EFFECTS OF PROLONGED DRYNESS OR WETNESS ON WATER SENSITIVE ECONOMIES, DESIGNATING DISASTER AREAS OF DROUGHT OR WETNESS; AND REFLECTING THE GENERAL LONG-TERM STATUS OF WATER SUPPLIES IN AQUIFERS, RESERVOIRS, AND STREAMS.

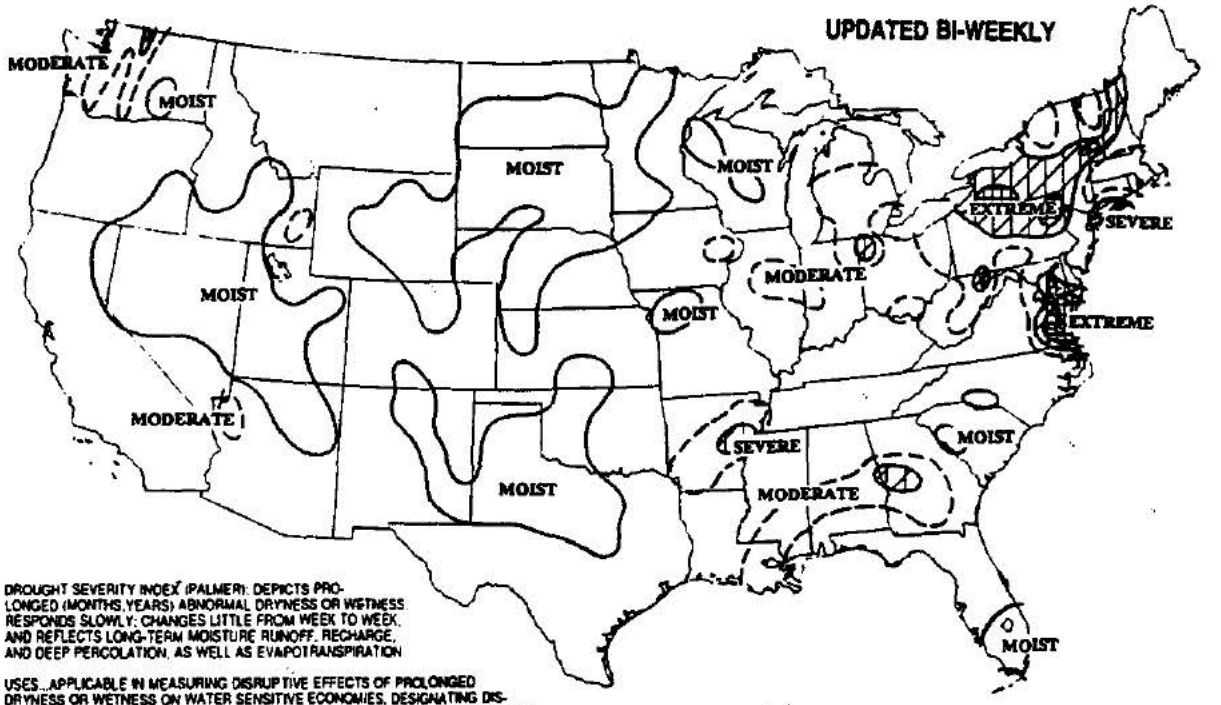
LIMITATIONS...IS NOT GENERALLY INDICATIVE OF SHORT-TERM (FEW WEEKS) STATUS OF DROUGHT OR WETNESS SUCH AS FREQUENTLY AFFECTS CROPS AND FIELD OPERATIONS (THIS IS INDICATED BY THE CROP MOISTURE INDEX)

NOAA/USDA JOINT AGRICULTURAL WEATHER FACILITY

Based on preliminary reports

DROUGHT SEVERITY
(LONG TERM, PALMER)

September 30, 1995



DROUGHT SEVERITY INDEX (PALMER): DEPICTS PROLONGED (MONTHS,YEARS) ABNORMAL DRYNESS OR WETNESS. RESPONDS SLOWLY; CHANGES LITTLE FROM WEEK TO WEEK; AND REFLECTS LONG-TERM MOISTURE RUNOFF, RECHARGE, AND DEEP PERCOLATION, AS WELL AS EVAPOTRANSPIRATION.

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NOAA/USDA JOINT AGRICULTURAL WEATHER FACILITY

Based on preliminary reports

PLATE 8

CORPS PROJECTS

BEAR CREEK DAM AND LAKE
BEAR CREEK, SOUTH PLATTE RIVER BASIN, COLORADO
1994-1995 REGULATION

The Omaha District entered into two temporary one year storage contracts for municipal and industrial water supply under Section 6 of the Flood Control Act of 1944 (Public Law 34, 78th Congress), pending development of a long-term contract under the Water Supply Act of 1958 as amended (43 U.S.C. 390 b-f). The first contract dated September 17, 1987 was for 25 acre-feet with the Indian Hills Water District. This contract was renewed in October 1995. The cost of storage per acre-foot in each of these contracts is approximately $2800.00.

In response to the contracts for temporary water storage, a revised Memorandum of Understanding (MOU) between the Corps of Engineers and the State of Colorado was signed on June 20, 1988. This memorandum supersedes the previous MOU dated May 11, 1977. Under normal conditions the Bear Creek Dam outlet works is set to automatically pass streamflow up to 500 cfs when pool elevations are above the drop inlet-outlet weir crest of 5558.0 feet msl. When conditions warrant, higher releases are made by opening two slide service gates in the dome-type gated control structure buried under the embankment. Under the revised MOU, the State Engineer or his representative will determine the storage and releases necessary to satisfy downstream water right requirements when the pool level is below elevation 5559.0 feet msl. Elevation 5559.0 is one foot into the flood storage zone and was selected to allow flexibility in targeting authorized pool levels. Bear Creek Reservoir was not made operational during the report period as has been done in the past.

The State of Colorado, Department of Natural Resources, Division of Game, Fish and Parks, in a letter dated October 1, 1970, agreed to provide water for the initial filling and replenishment of evaporation losses from the recreation pool, by purchase or other means, consistent with Federal and State laws to assure effective operation of the project for recreation.

In January 1992, the Denver Regional Council of Governments (DRCOG) requested Corps of Engineers participation in a demonstration project at Bear Creek Reservoir using hypolimnetic withdrawals throughout the year. The water quality in the reservoir and downstream of the reservoir would be monitored to assess the effectiveness of this management practice on water quality. The Corps of Engineers would make variable releases throughout the year depending on the inflow. The table below shows the approximate release targets as requested by DRCOG.

STREAMFLOW	RELEASE
> 20 cfs	10 cfs
15-20 cfs	7-9 cfs
10-15 cfs	5-6 cfs
< 10 cfs	0 cfs

Release changes were made weekly as needed throughout the year. The low level releases for water quality were continued through late 1994.

In March, the District 9 Water Commissioner requested release of Lakewood's stored water. This release involved 5 cfs through the first part of April. During the first 2 weeks of April, due to low reservoir levels, a low level release of 6 cfs was made to satisfy downstream water rights. On April 11th the reservoir was returned to its normal fill and spill operation and up to 500 cfs release.

Beginning on June 13th, the gates were closed from a release of 500 cfs to a release of 100 cfs for flood control operation and lowering of flows downstream to facilitate a levee repair. (See Section VI for details of this years flood operation)

Runoff during the report period was 186% of normal. Snowmelt runoff occurred during April through June with inflows reported at 225% of the historic average. Runoff peaked in June with 28,318 AF of inflow to the project. This was 357% of normal. A new record pool was set on June 17th at 5587.17. A total of 5135 AF or 18% of the 28,757 AF flood storage zone was utilized at the maximum pool elevation of 5587.17.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	910 cfs May 01 80	800 cfs May 5-12 80
2nd	795 cfs Jun 10 95	800 cfs Jun 12 79
3rd	690 cfs Jun 10 79	612 cfs Jun 25

	Pool-Date
Highest	5587.17 Jun 17 95
2nd	5581.0 Jun 23 83
3rd	5576.3 May 19 80

Minimums of Record (since initial fill):

	Pool-Date
Lowest	5556.98 Feb 09 82
2nd	5557.08 Jul 09 86

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
67,275, 186% of normal

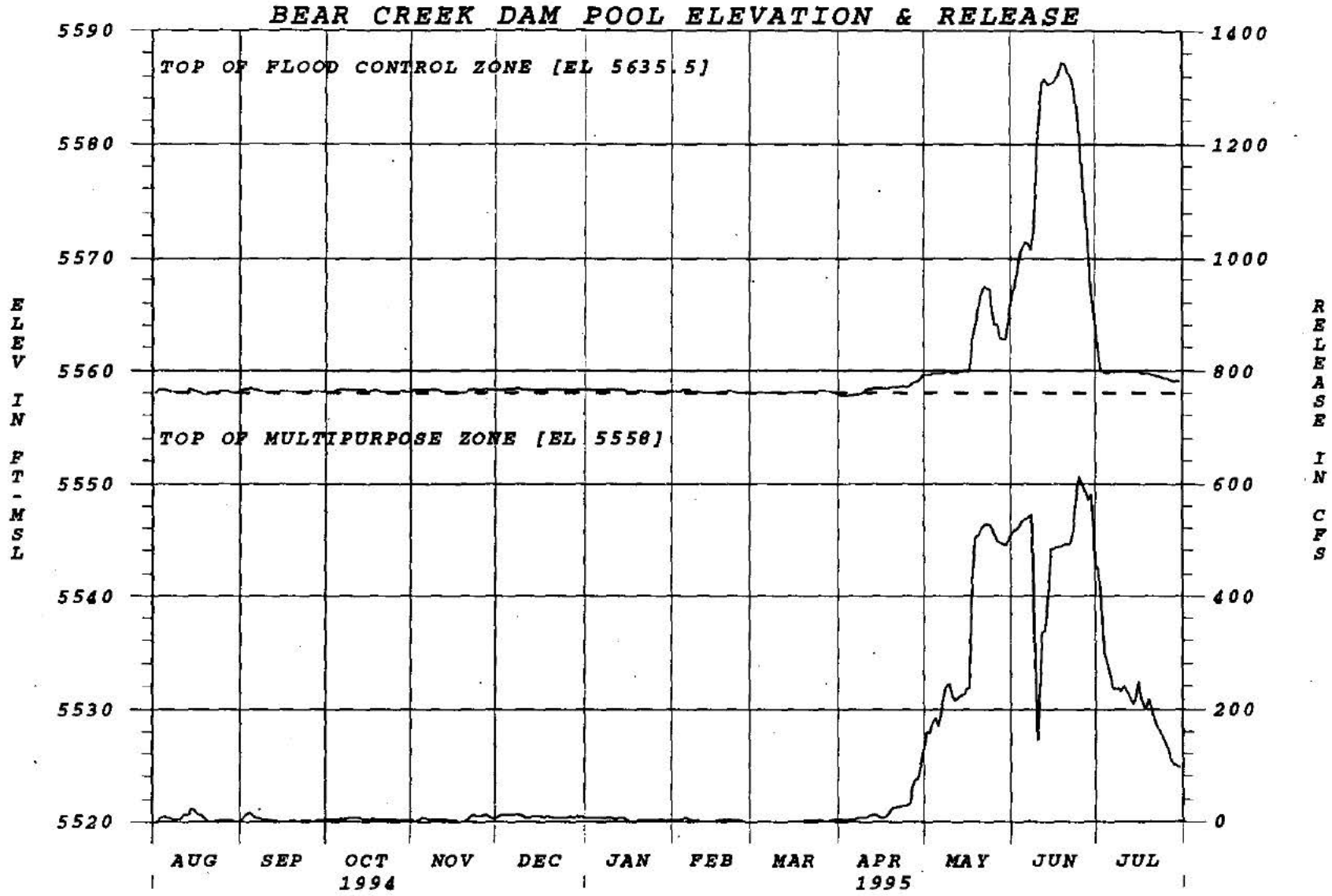
Total Outflow (AF)
66,769, 187% of normal

Peak Daily Inflow (CFS)
795, Jun 10

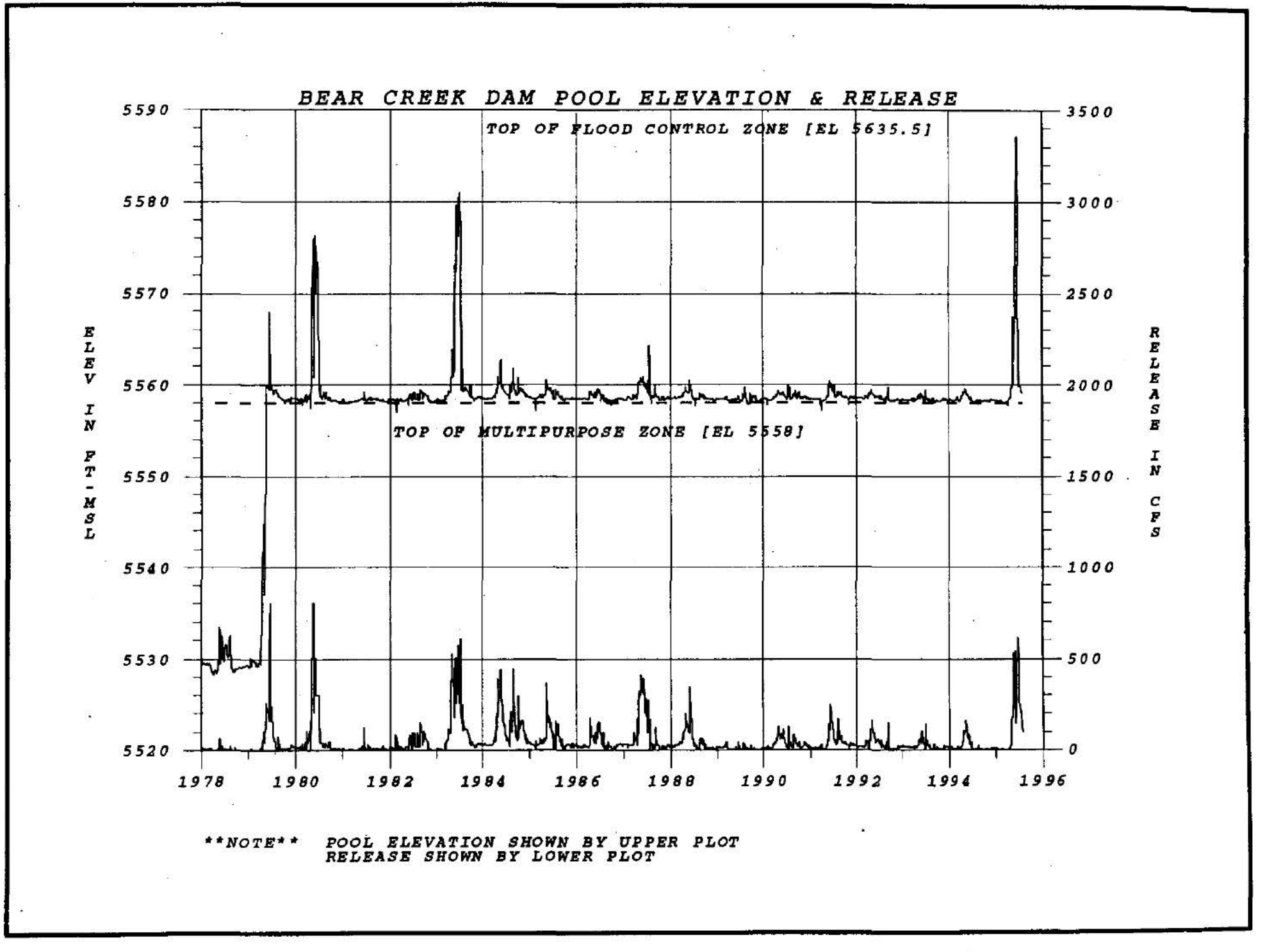
Peak Daily Outflow (CFS)
612, Jun 25

Peak Pool Elevation (Feet msl)
5587.17, Jun 17

Minimum Pool Elevation (Feet msl)
5557.68, Apr 03



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


BEAR CREEK DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 5635.5]
TOP OF MULTIPURPOSE ZONE [EL 5558]
ELEV IN FT-MSL
RELEASE IN CFS
5590
5580
5570
5560
5550
5540
5530
5520
3500
3000
2500
2000
1500
1000
500
0
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

BOWMAN-HALEY DAM AND LAKE
GRAND RIVER BASIN, NORTH DAKOTA
1994-1995 REGULATION

In anticipation of substantial spring snowmelt, the low level gate was opened in February and wasn't closed until June. An estimated 18,447 acre-feet or 40% of the total 46,520 acre-feet that was discharged passed through the low-level and mid-level outlets.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	5,310 cfs Mar 27 78	2,390 cfs Mar 28 78
2nd	2,135 cfs Jun 14 92	1,256 cfs May 15 95
3rd	2,096 cfs May 09 95	1,125 cfs Mar 14 72

	Pool-Date
Highest	2762.66 Mar 28 78
2nd	2758.78 May 14 95
3rd	2758.50 Mar 13 72

Minimums of Record (since initial fill):

	Pool-Date
Lowest	2747.57 Jun 12 92
2nd	2749.17 Jul 31 91
3rd	2749.93 Nov 16 81

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
46,520, 189% of normal

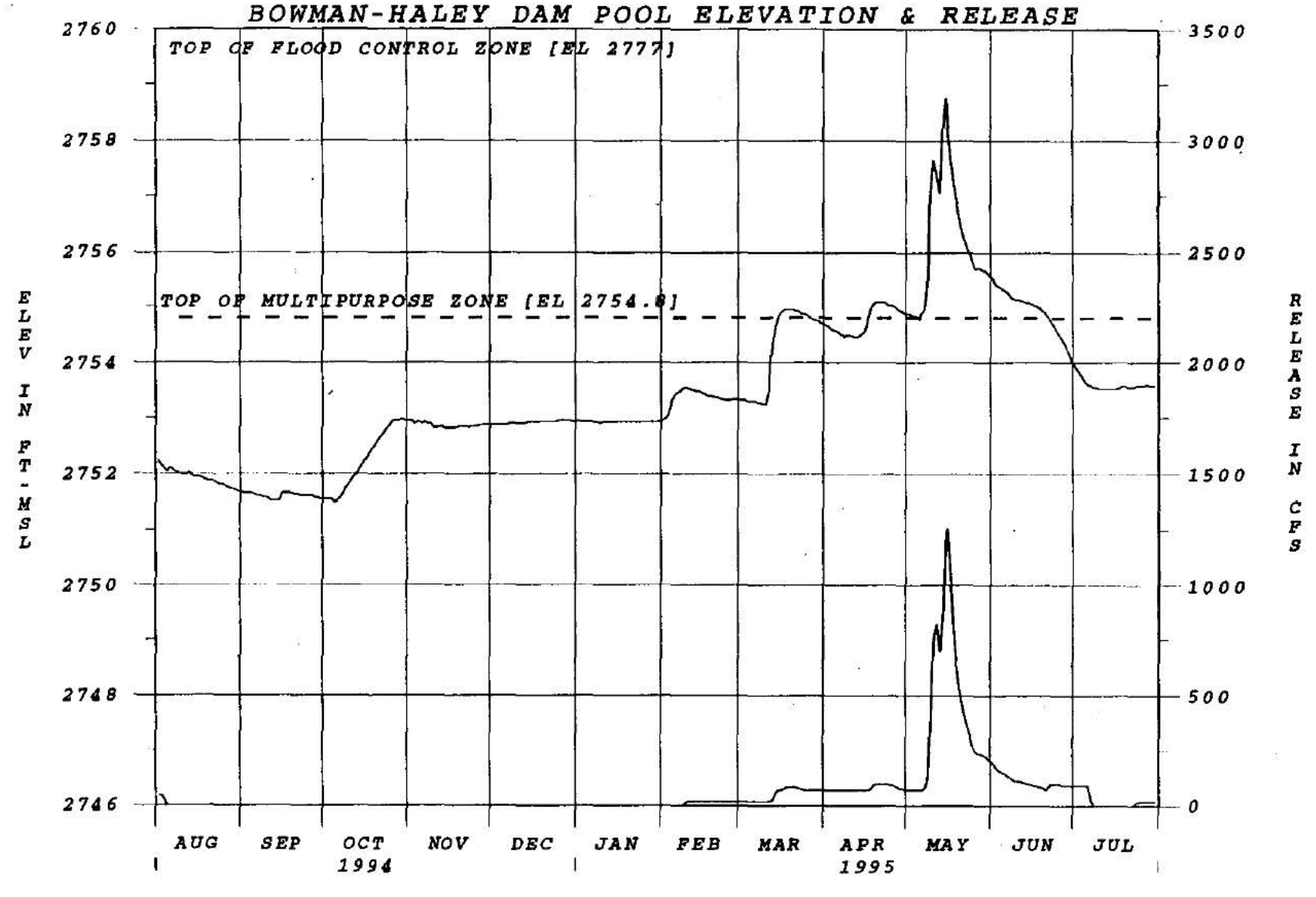
Total Outflow (AF)
42,298, 316% of normal

Peak Daily Inflow (CFS)
2096, May 09

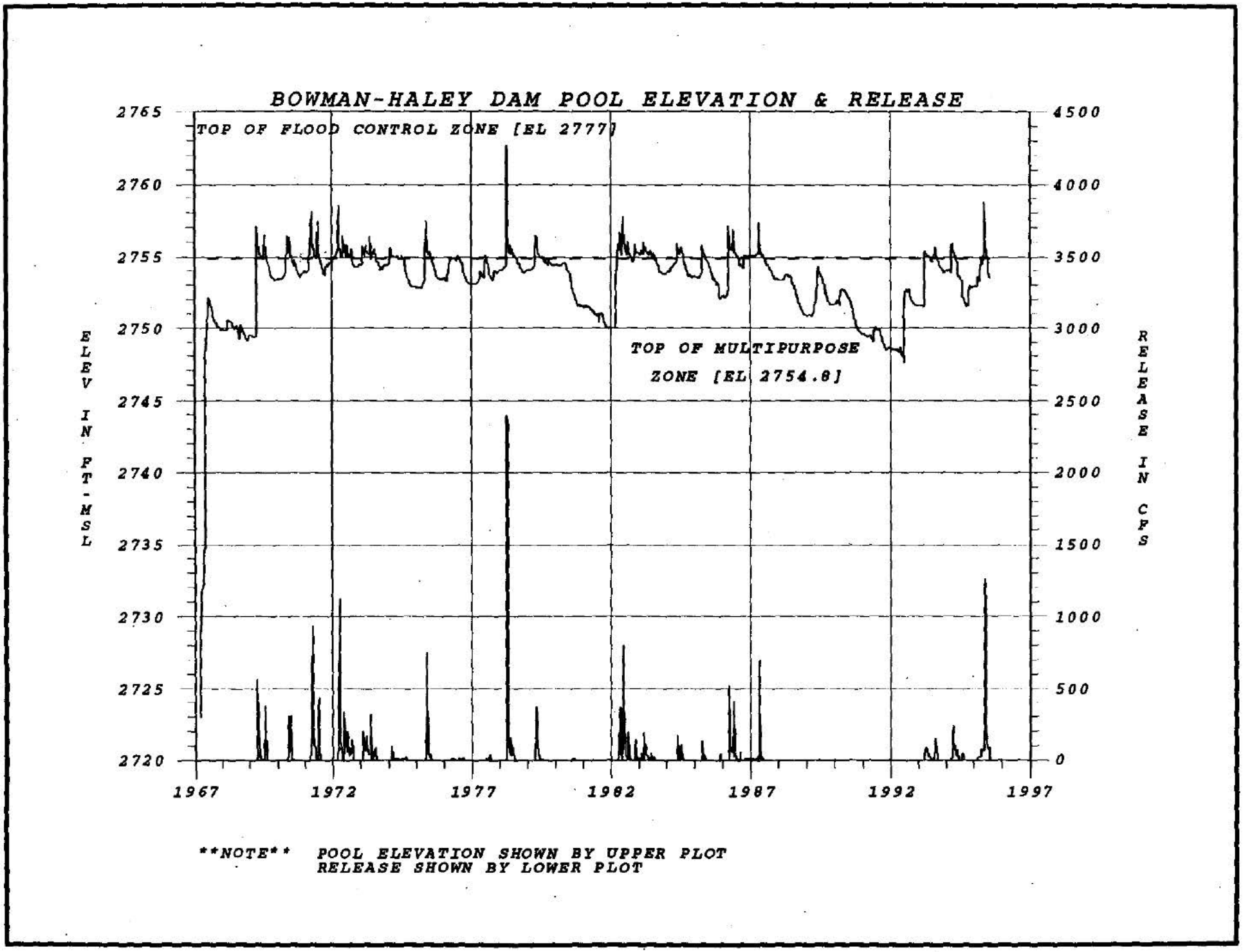
Peak Daily Outflow (CFS)
1256, May 15

Peak Pool Elevation (Feet msl)
2758.77, May 14

Minimum Pool Elevation (Feet msl)
2751.50, Sep 14



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


BOWMAN-HALEY DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 2777]
TOP OF MULTIPURPOSE ZONE [EL 2754.8]
ELEV IN FT-MSL
RELEASE IN CFS
2765
2760
2755
2750
2745
2740
2735
2730
2725
2720
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1967
1972
1977
1982
1987
1992
1997
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

BULL HOOK-SCOTT COULEE DAMS
MILK RIVER BASIN, MONTANA
1994-1995 REGULATION

Bull Hook and Scott Coulee Dams are both part of the Bull Hook Unit providing flood control for the city of Havre, Montana. Bull Hook and Scott Coulee Dams are both located south of Havre on Bull Hook and Scott Coulee Creeks, respectively.

Under normal circumstances, the conduit valves of both dams will be kept partially open to evacuate accumulated storage as expeditiously as possible to allow the dams to function as flood protection facilities if excess runoff occurs upstream. Valve openings are to be maintained that will allow only the minimal damages to occur in the city of Havre.

At times of high flows on the Milk River, it may be necessary to shut off releases in both dams to prevent flooding behind the Milk River levees.

CEDAR CANYON DAM (RED DALE GULCH)
RAPID CREEK BASIN, SOUTH DAKOTA
1994-1995 REGULATION

Cedar Canyon Dam is located on the western outskirts of Rapid City, South Dakota. The dam is designed as a detention structure with no permanent storage, however, a small pool may sometimes exist in the dead storage below the invert of the outlet pipe. The dam collects runoff from approximately 261 acres. The outlet and spillway are uncontrolled. No water accumulated during the report period. Inflow was negligible and outflow was zero for the period. No flood control was achieved.

CHATFIELD DAM AND LAKE
SOUTH PLATTE RIVER BASIN, COLORADO
1994-1995 REGULATION

Before the dam became operational, the Corps (CEMRO-ED-HC) requested that the Colorado State Engineers Office, acting through the District 8 Water Commissioner, assume responsibility for determining releases from the multipurpose pool in an effort to keep the Corps free of water rights conflicts. This relationship was put into a formal document dated March 30, 1973 when the multipurpose pool was increased from elevation 5430.0 to 5432.0 feet msl and contained water storage commitments by the State. By contract, the State is committed to keeping the pool above elevation 5423.0 for recreation and fish and wildlife purposes. Since 1979, the City of Denver through the State of Colorado has been permitted to regulate storage in the conservation pool in return for the city's commitment to provide sufficient water in the pool for recreation. The city is committed to keeping 20,000 acre-feet (Elevation 5426.94 feet msl) of water in the pool from May 1 through August 31, and permitted to use 10,000 acre-feet of storage space in the reservoir between elevations 5423.8 and 5432.0 feet msl. The original top of multipurpose pool level was at elevation 5426.0 feet msl.

The flood control operation of Chatfield Reservoir began May 18th with a release of 750 cfs to evacuate flood storage and lower the reservoir to elevation 5432.0, and continued into mid-July. Snowmelt runoff was nearly 280% of normal and caused high stages much of May, June, and July. The total inflow for the reporting period was 314,540 acre-feet (193% of normal). (For detailed summary of 1995 flood operation at Chatfield see Section VI)

Flood storage space utilized was 25,511 acre-feet of 206,945 acre-feet or 12% of the flood storage space at the maximum pool elevation of 5446.40 feet msl on July 4.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	3,390 cfs Jul 03 95	3,034 cfs May 15 84
2nd	3,370 cfs May 30 83	3,027 cfs May 27 87
3rd	3,155 cfs May 09 80	2,858 cfs Jul 08 83

	Pool-Date
Highest	5447.58 May 26 80
2nd	5447.08 Jun 30 83
3rd	5446.40 Jul 04 95

Minimums of Record (since initial fill):

	Pool-Date
Lowest	5424.33 Nov 21 90
2nd	5424.46 Nov 17 85

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
314,540, 193% of normal

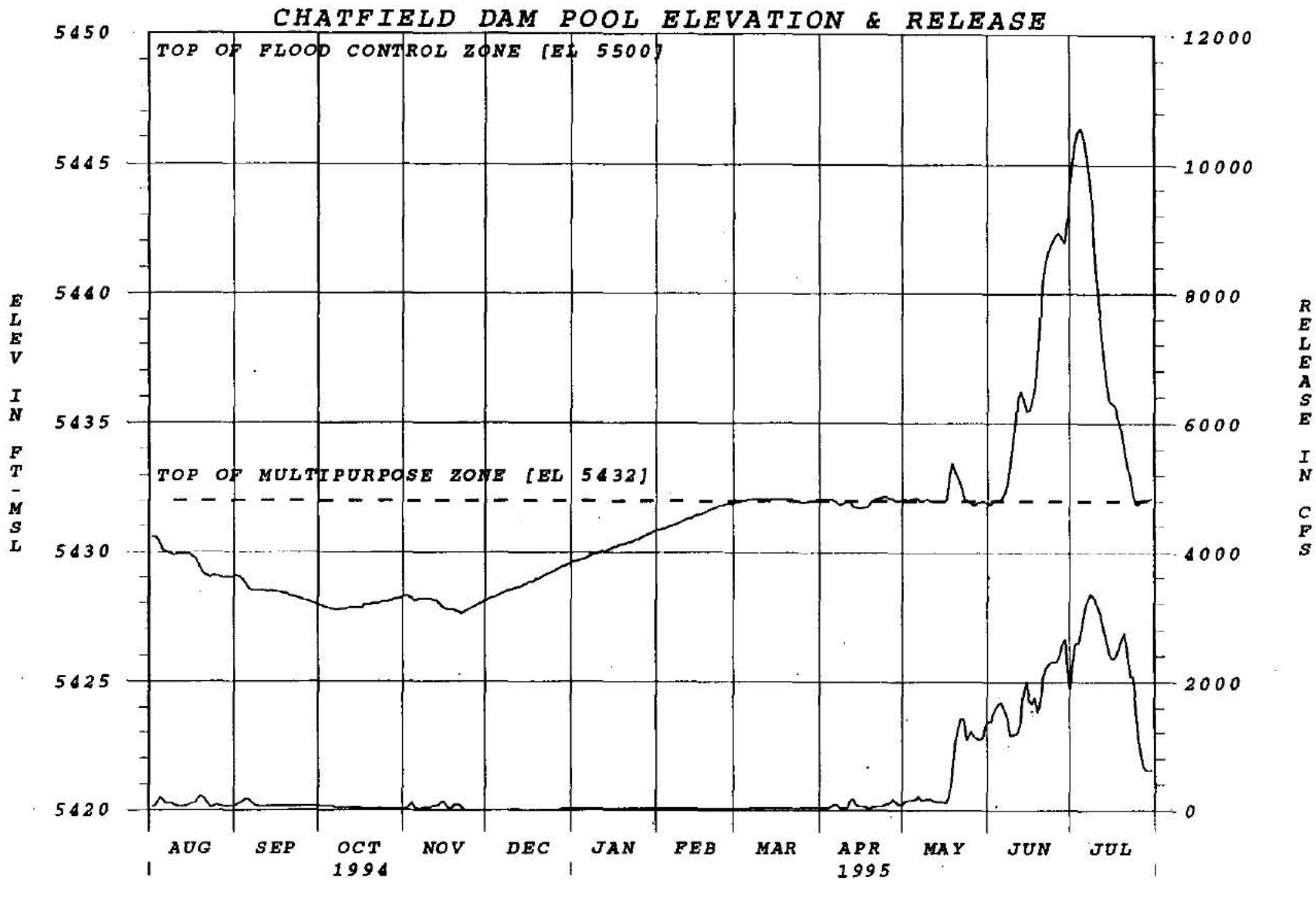
Total Outflow (AF)
308,100, 193% of normal

Peak Daily Inflow (CFS)
3390, Jul 03

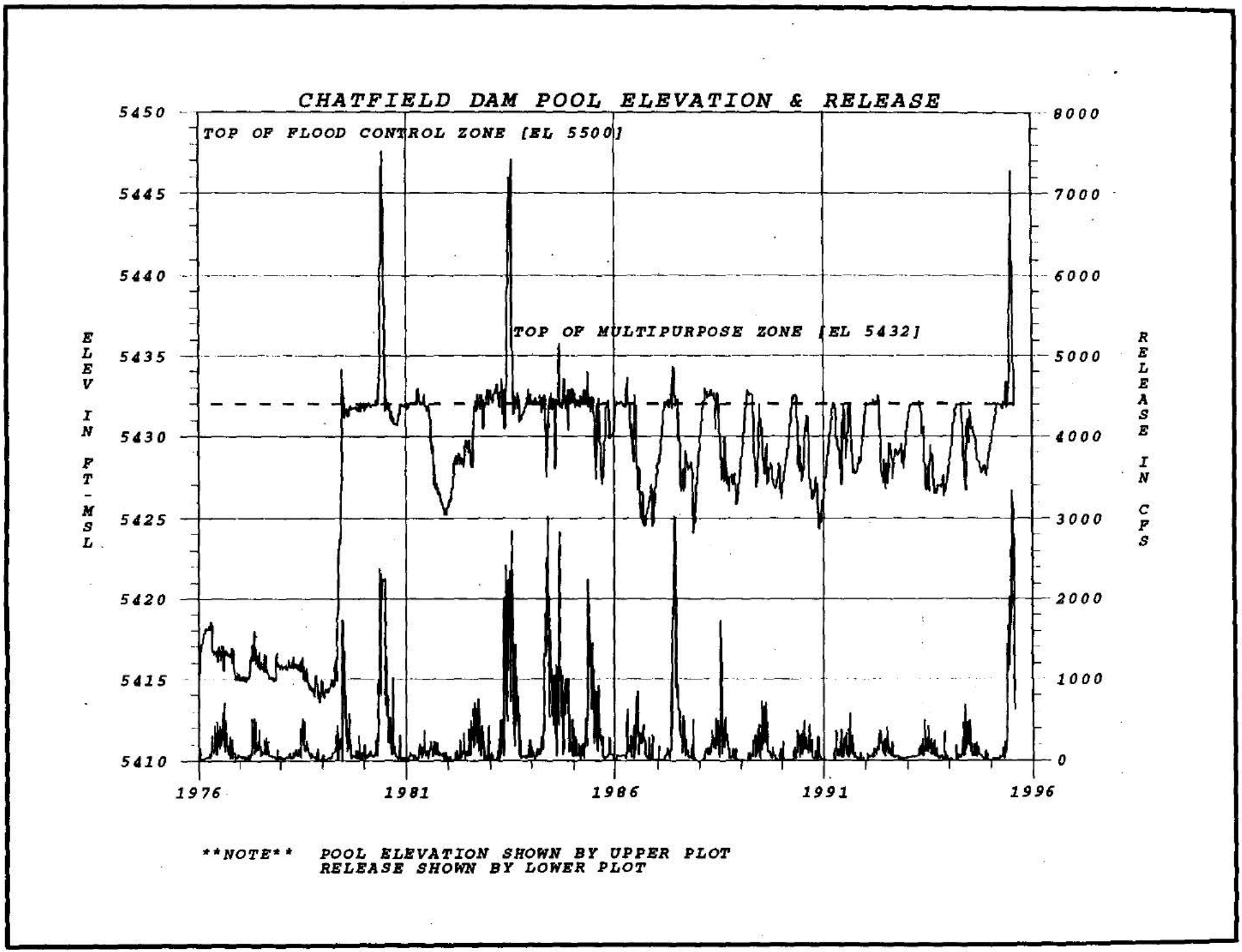
Peak Daily Outflow (CFS)
3350, Jul 08

Peak Pool Elevation (Feet msl)
5446.40, Jul 04

Minimum Pool Elevation (Feet msl)
5427.62, Nov 22



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


CHATFIELD DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 5500]
TOP OF MULTIPURPOSE ZONE [EL 5432]
ELEV IN FT-MSL
RELEASE IN CFS
5450
5445
5440
5435
5430
5425
5420
5415
5410
8000
7000
6000
5000
4000
3000
2000
1000
0
1976
1981
1986
1991
1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

CHERRY CREEK DAM AND LAKE
CHERRY CREEK, SOUTH PLATTE RIVER BASIN, COLORADO
1994-1995 REGULATION

Releases from the project are made to evacuate flood control zone storage and to meet downstream calls. Each year, water is released from four of the five gates to flush accumulated sediment.

The flushing operation to remove sediment from the intake structure was accomplished on May 10-11. Releases consisted 300 cfs for 30 minutes and 1200 cfs for 10 minutes from each of the 4 gates. Sediment within the intake structure around the gates was successfully removed during the exercise.

Inflows to Cherry Creek Reservoir for the report period were 11,113 acre-feet, 144% of average. The peak monthly inflow occurred in May, with 3919 acre-feet entering the reservoir. The peak daily inflow was 247 cfs on May 27th.

Urban Drainage and Flood Control District continued their work to improve the Cherry Creek channel downstream of the dam during the report period. Several drop structures and channel stabilization projects were added in this reach. Work was also being done to the channel near the golf course just downstream of the project. The golf course was adding several streambank protection projects and access bridges.

A total of 854 acre-feet or about 1.1% of the 79,960 acre-feet exclusive flood storage zone was utilized at the maximum pool elevation of 5551.00 on May 19. Minimal downstream flooding was prevented by this project.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	6,150 cfs Jun 16 65	560 cfs Aug 7-8 65
2nd	3,195 cfs May 06 73	375 cfs Jun 08 75
3rd	1,440 cfs Jul 24 83	330 cfs Apr 23-May 1 83 May 28-Jun 2 83

	Pool-Date
Highest	5565.82 Jun 03 73
2nd	5562.52 Aug 01 65
3rd	5557.89 Jul 25 83

Maximum Hourly Inflow: 56,000 cfs 7-8 p.m., June 16, 1965

Minimums of Record (since initial fill):

	Pool-Date
Lowest	5543.51 Jan 29 65
2nd	5545.90 Nov 23-24 78

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
11,113, 144% of normal

Total Outflow (AF)
8132, 161% of normal

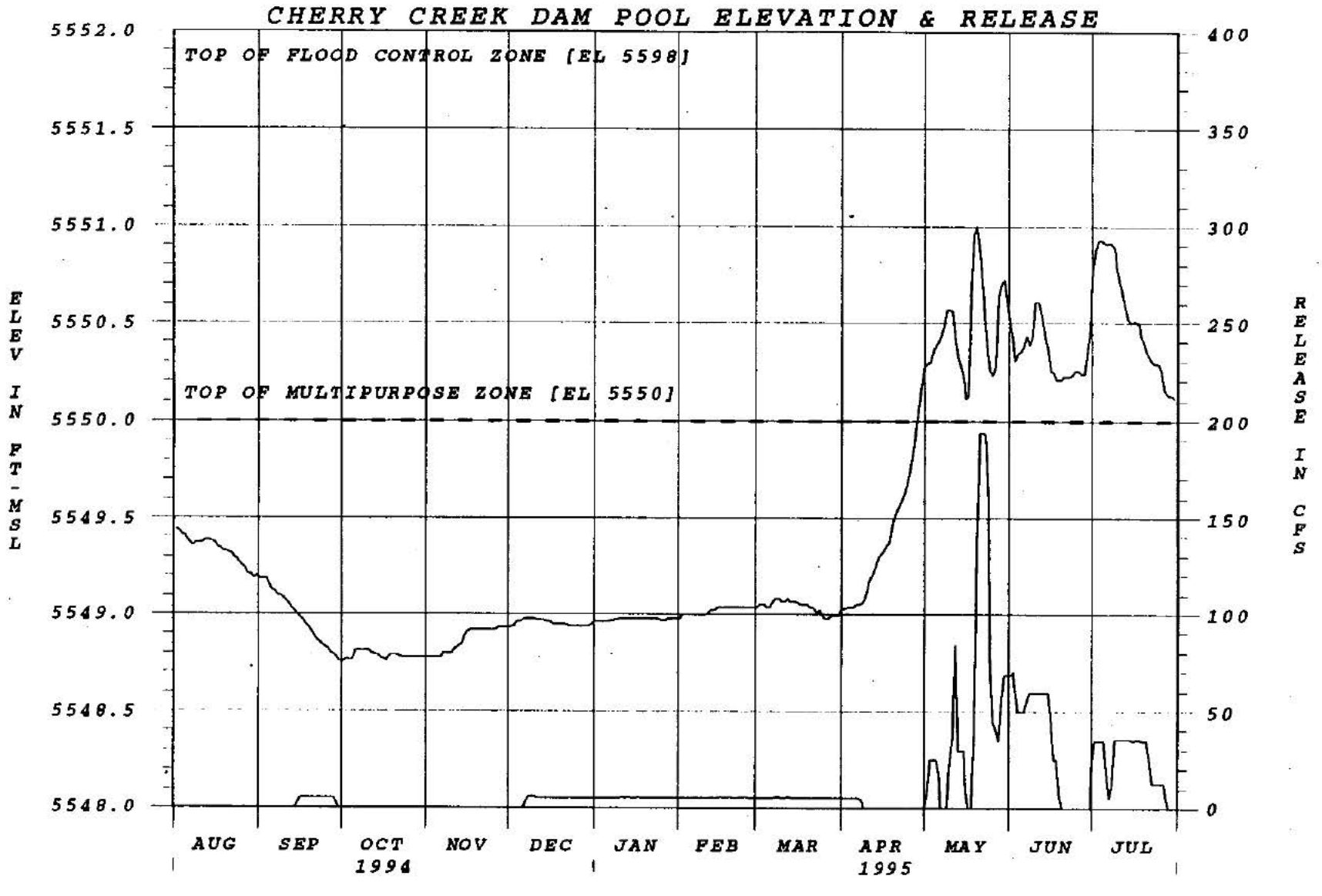
Peak Daily Inflow (CFS)
247, May 27

Peak Daily Outflow (CFS)*
195, May 20

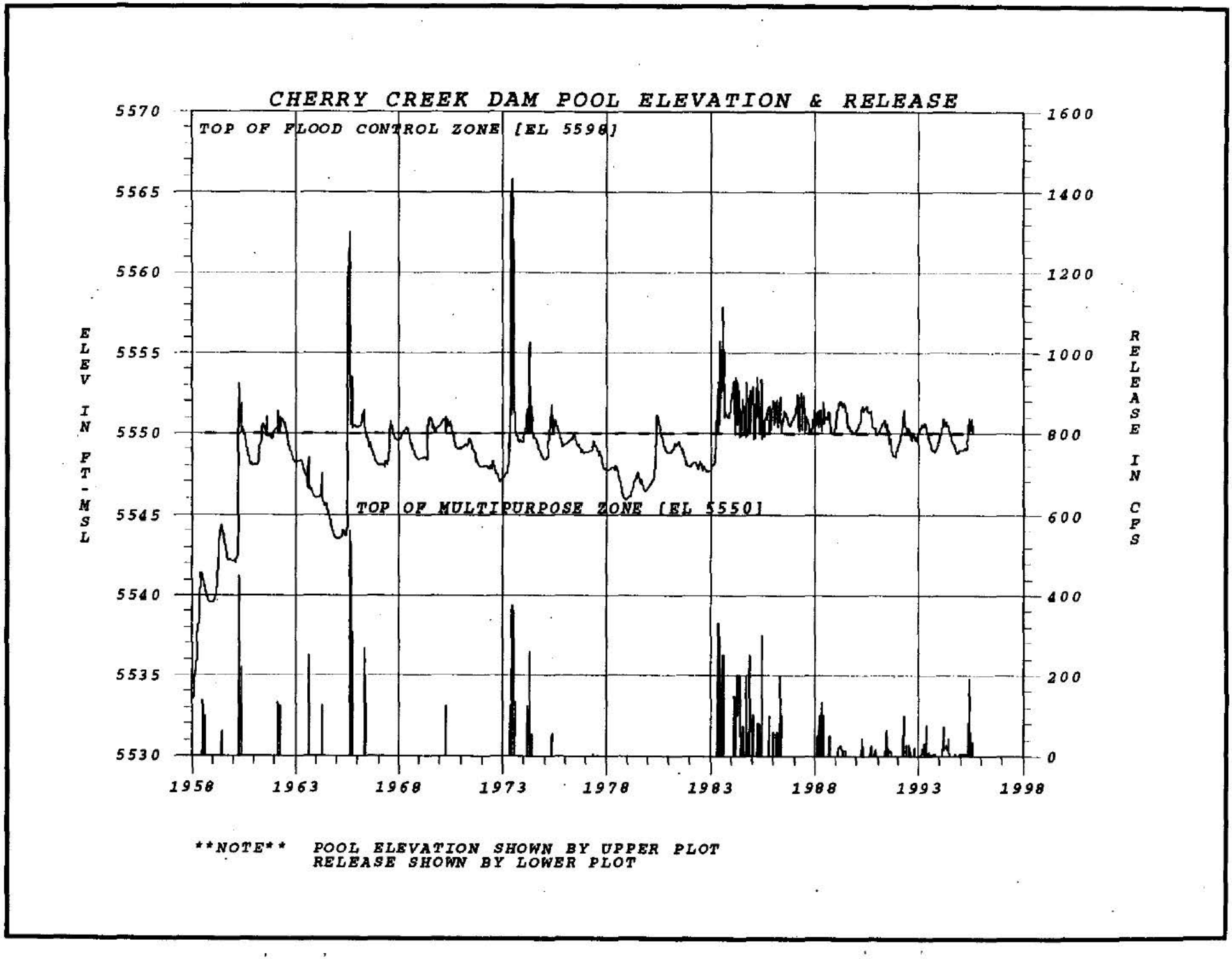
* Not including flushing exercise

Peak Pool Elevation (Feet msl)
5551.0, May 19

Minimum Pool Elevation (Feet msl)
5548.75, Sep 30



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


CHERRY CREEK DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 5596]
TOP OF MULTIPURPOSE ZONE [EL 5550]
ELEV IN FT-MSL
RELEASE IN CFS
5570
5565
5560
5555
5550
5545
5540
5535
5530
1600
1400
1200
1000
800
600
400
200
0
1958
1963
1968
1973
1978
1983
1988
1993
1998
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

COLDBROOK DAM AND LAKE
FALL RIVER BASIN, SOUTH DAKOTA
1994-1995 REGULATION

Releases from Coldbrook Reservoir are regulated to comply with State water law. Larive Lake Resort, located below the dam, holds a senior water right entitling it to the Coldbrook Reservoir inflow up to 1.1 cfs. A wet fall resulted in increased spring activity for most of the report period. Water was spilled from the project from November, 1994 to the present. The maximum discharge of 3.0 cfs disappeared into the ground below the project.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	74 cfs Jul 14 62	4.3 cfs Mar 02 94
2nd	65 cfs Jul 08 61	3.0 cfs Jul 16 95
3rd	40 cfs May 19 82	2.4 cfs Mar 23 87

	Pool-Date
Highest	3585.41 Jul 16 95
2nd	3585.38 Mar 01 94
3rd	3585.38 Aug 17 82

Minimums of Record (since initial fill):

	Pool-Date
Lowest	3576.6 Oct 22 77
2nd	3576.8 Sep 14-Oct 02 81 Sep 21-22-77

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
674, 123% of normal

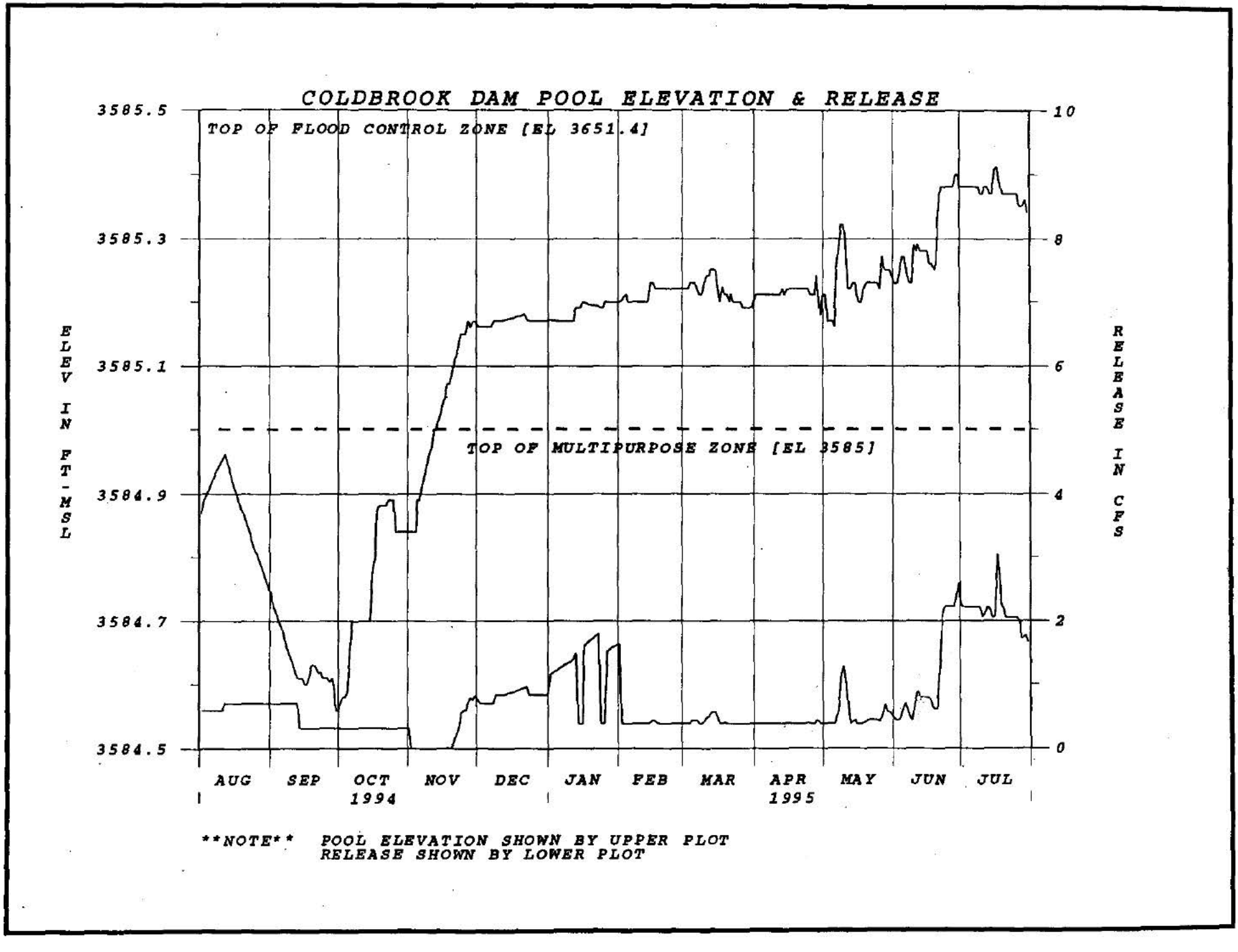
Total Outflow (AF)
535, 106% of normal

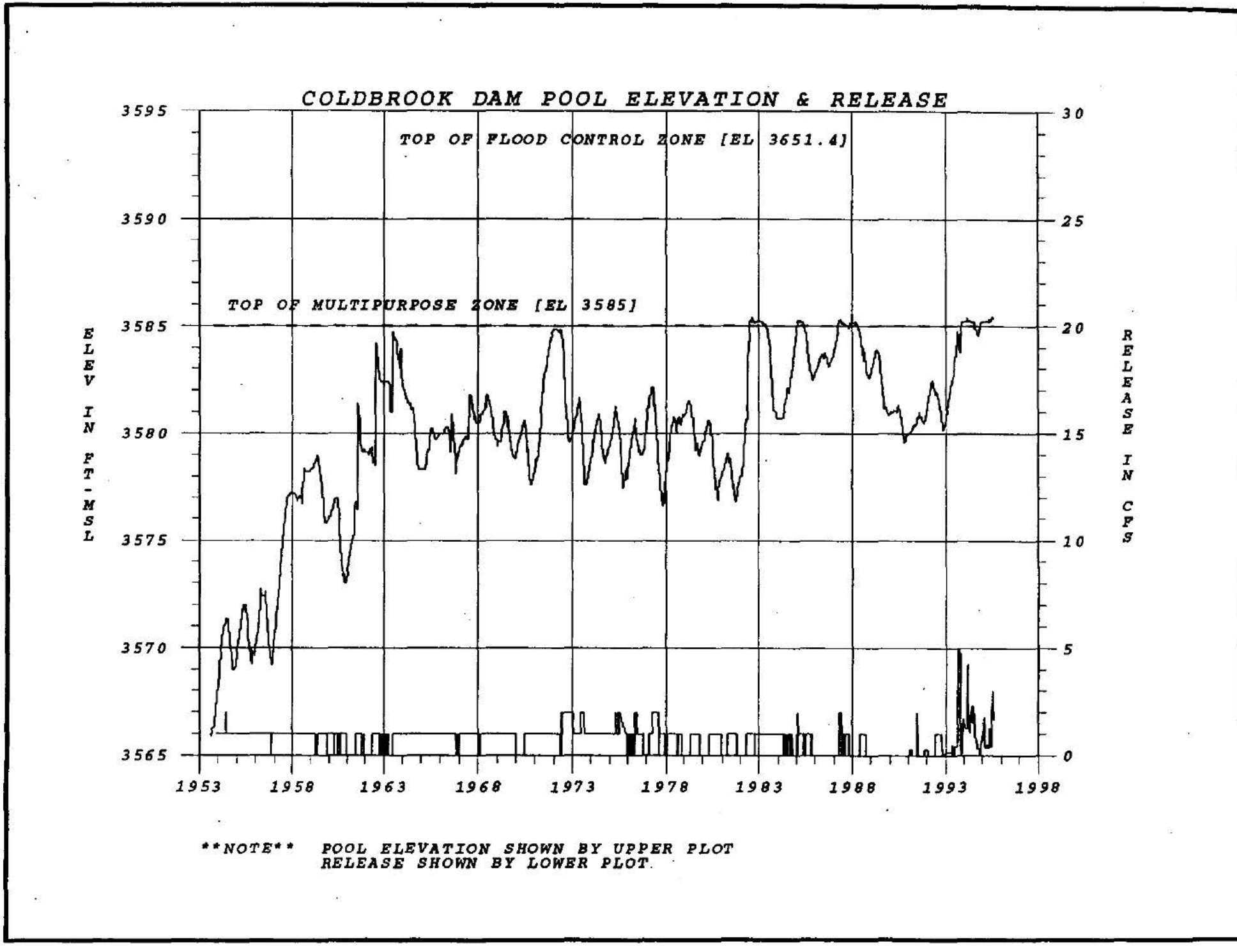
Peak Daily Inflow (CFS)
3.0, Jul 16

Peak Daily Outflow (CFS)
3.0, Jul 16

Peak Pool Elevation (Feet msl)
3585.41, Jul 16

Minimum Pool Elevation (Feet msl)
3584.51, Oct 31


COLDBROOK DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 3651.4]
TOP OF MULTIPURPOSE ZONE [EL 3585]
3585.5
3585.3
3585.1
3584.9
3584.7
3584.5
ELEV IN FT-MSL
10
8
6
4
2
0
RELEASE IN CFS
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

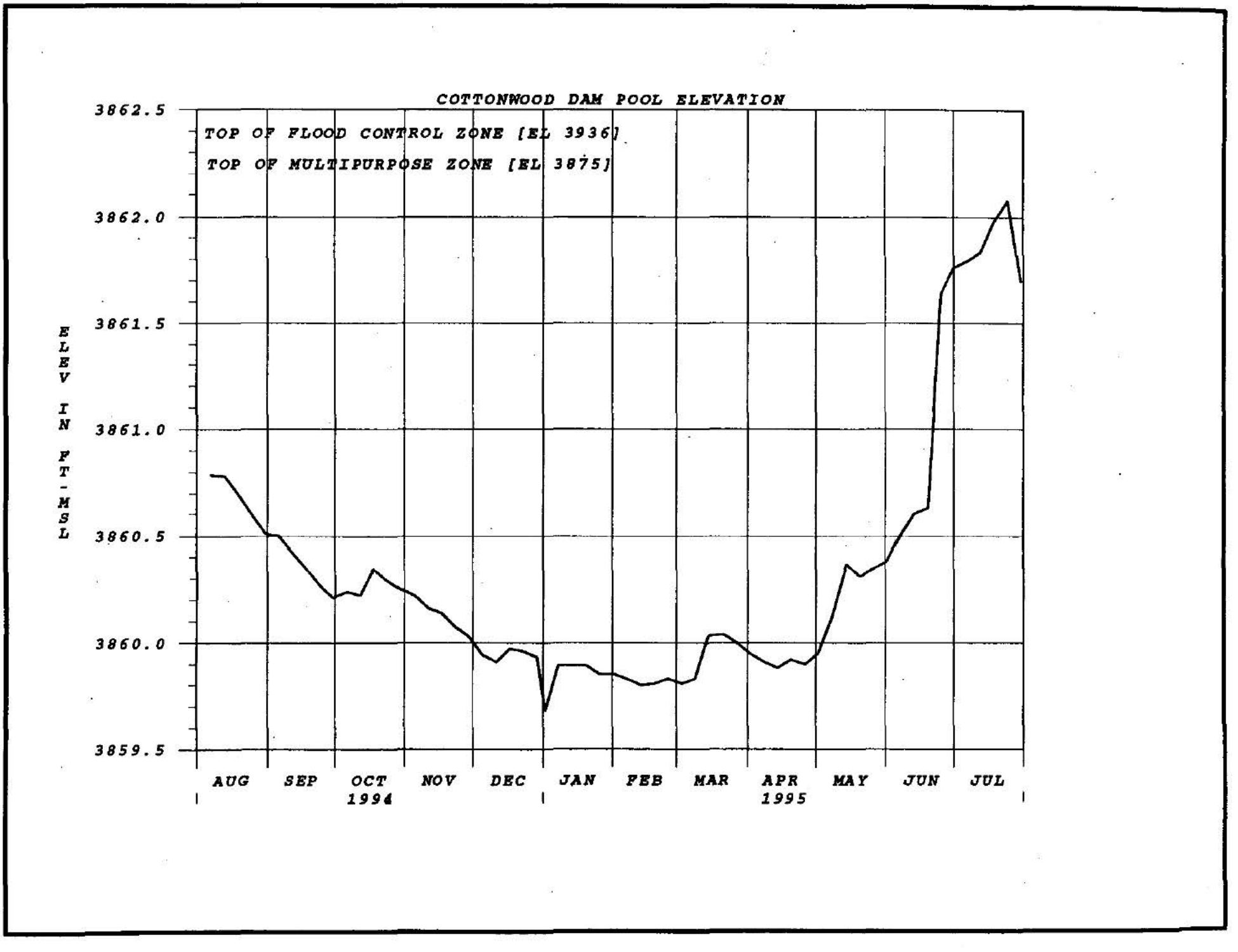

COLDBROOK DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 3651.4]
TOP OF MULTIPURPOSE ZONE [EL 3585]
ELEV IN FT-MSL
RELEASE IN CFS
3595
3590
3585
3580
3575
3570
3565
30
25
20
15
10
5
0
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT.

COTTONWOOD SPRINGS DAM AND LAKE
FALL RIVER BASIN, SOUTH DAKOTA
1994-1995 REGULATION

Cottonwood Springs Creek dam is located on Cottonwood Springs Creek approximately 1/2 mile above its confluence with Hot Brook, a tributary of Fall River. The site is located 4.5 miles west of Hot Springs, Fall River County, South Dakota. The purpose for the project is to provide flood protection for Hot Springs, South Dakota and along the Fall River. Wet fall, winter and spring conditions resulted in increased spring activity. The pool rose 2.5 feet during 1995 to a record high level of 3862.11 ft, msl.

Maximums of Record:

	Pool Date	**Daily Inflow-Date**	**Daily Outflow-Date**
Highest	3862.11 Jul 25 95	--	--
2nd	3861.0 Jun 25 94		
3rd	3847.9 Jun 09 79		


COTTONWOOD DAM POOL ELEVATION
TOP OF FLOOD CONTROL ZONE [EL 3936]
TOP OF MULTIPURPOSE ZONE [EL 3875]
ELEV IN FT-MSL
3862.5
3862.0
3861.5
3861.0
3860.5
3860.0
3859.5
AUG
SEP
OCT
1994
NOV
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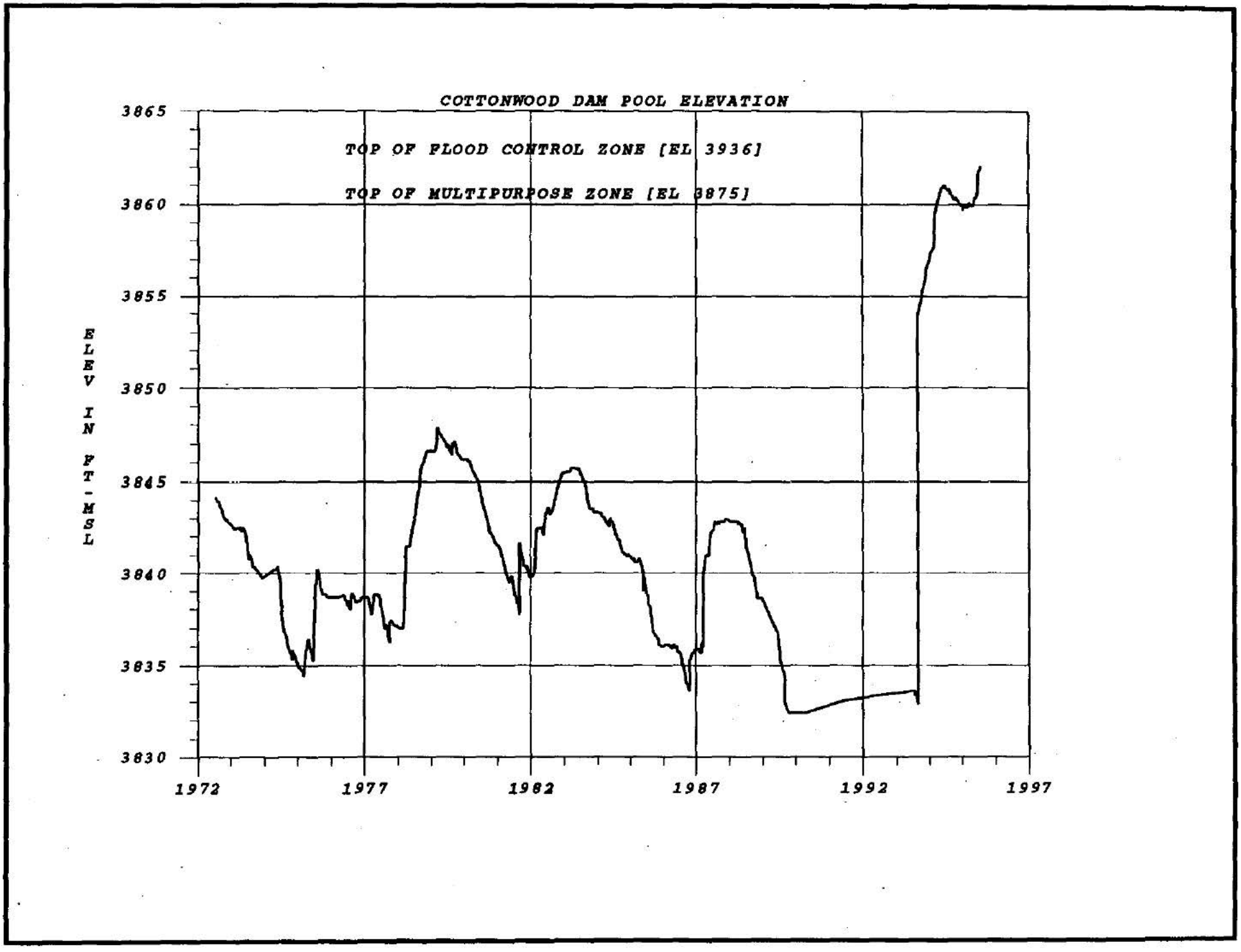
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL


COTTONWOOD DAM POOL ELEVATION
TOP OF FLOOD CONTROL ZONE [EL 3936]
TOP OF MULTIPURPOSE ZONE [EL 3875]
ELEV IN FT-MSL
3865
3860
3855
3850
3845
3840
3835
3830
1972
1977
1982
1987
1992
1997

KELLY ROAD DAM
SAND CREEK BASIN, COLORADO
1994-1995 REGULATION

Kelly Road Detention Dam is located on Westerly Creek, a tributary of Sand Creek and the South Platte River and provides flood control for the city of Aurora, Colorado. It is located entirely within the boundaries of Lowry Air Force Base. The project's sole purpose is flood control and was not designed to permanently store water. Water is automatically impounded by the project and released through a ground level 24-inch CMP conduit or high overflow inlet. A gate on the 24-inch conduit is kept in the open position. The intended closure of the gate is to contain oil or other spills within the air base. The city of Aurora is responsible for obtaining pool gage readings during flood periods and general observation of project operation.

Inflows and outflows were negligible for the report period. No flood control was achieved.

WESTERLY CREEK DAM
SAND CREEK BASIN, COLORADO
1994-1995 REGULATION

The Westerly Creek Dam is located approximately 0.8 miles upstream from the Kelly Road Dam on the southern edge of Lowry Air Force Base. Construction of Westerly Creek Dam was completed in July 1991. Both the dam and the detention area are located within the confines of the Lowry Air Force Base and were constructed for the purpose of flood control. The reservoir is generally dry and no permanent storage is provided. The reservoir is discharged by an orifice - controlled outlet structure and overflow spillway. The capacity of the outlet works is 98 cfs at a pool capacity elevation of 5,431.4 ft, MSL. Discharge from the outlet works is governed by the capacity of the existing 48-inch RCP storm sewer running into the Kelly Road pool. The sluice gate is intended to remain open unless overtopping of the Kelly Road Dam is imminent or the downstream storm sewer capacity is exceeded due to inflows from the downstream drainage area at this time the gate would be closed until downstream conditions permit releases from the Westerly Creek pool.

Inflows and outflows were negligible for the report period. No flood control was achieved.

GLENN CUNNINGHAM DAM AND LAKE
PAPILLION CREEK BASIN - NO. 11, NEBRASKA
1994-1995 REGULATION

The pool level stayed in the flood control zone up to September when it receded below the level for a brief time. Re-entered during September where it remained throughout the reporting period. Runoff and rainfall kept the pool level in the flood control zone through the reporting period. Heavy precipitation during April and May produce inflows of 88% and 203% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	362 cfs Jun 22 94	152 cfs Jun 18 84
2nd	345 cfs Jun 15 80	116 cfs Jun 16 80
3rd	344 cfs Mar 02 79	87 cfs Mar 04 79

	Pool-Date
Highest	1124.4 Jun 17 84
2nd	1123.7 Jun 15 80
3rd	1123.3 Jun 23 94

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1119.5 Nov 15 89
2nd	1120.2 Oct 30 90

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
6802, 89% of normal

Total Outflow (AF)
5920, 96% of normal

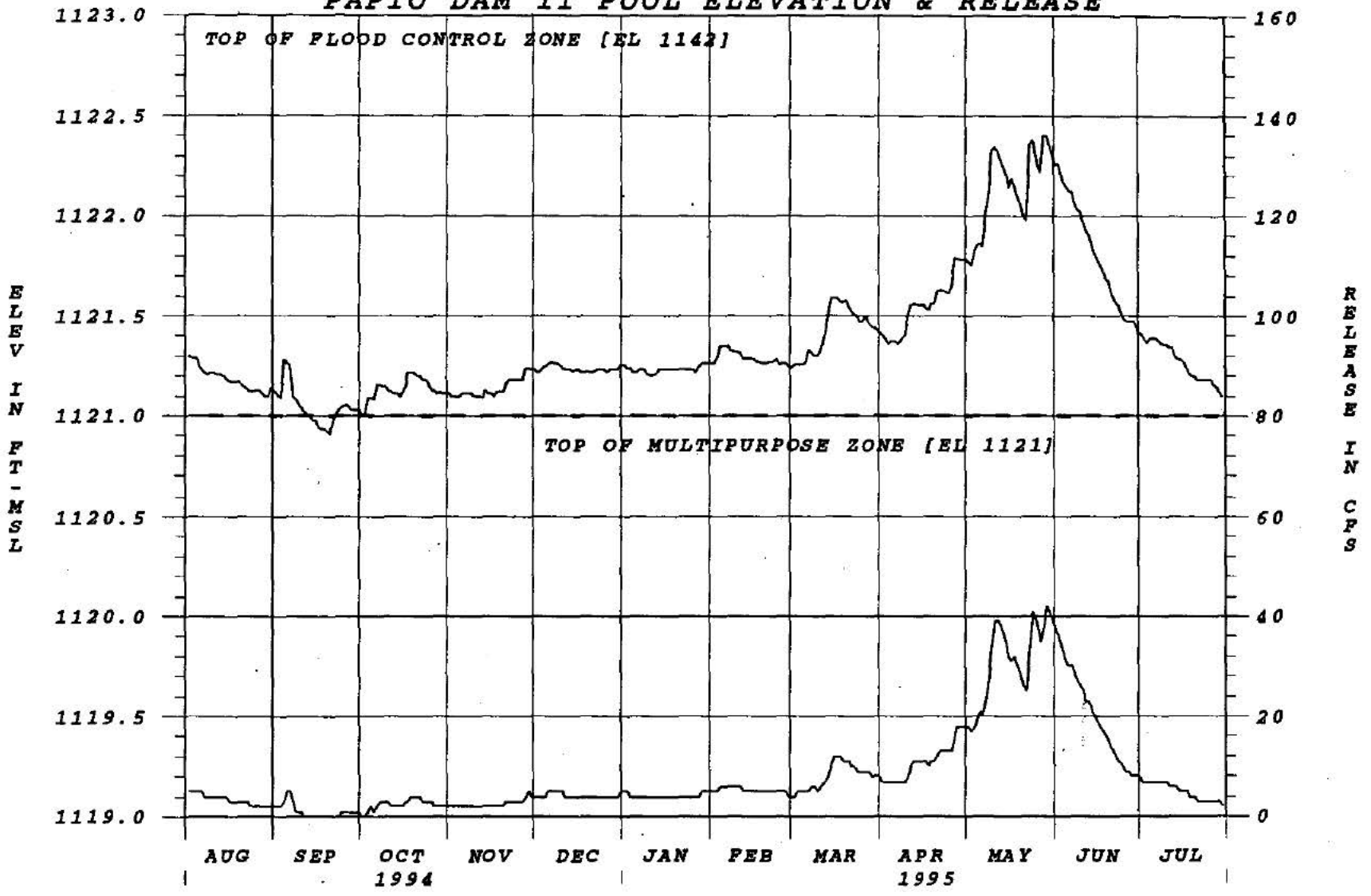
Peak Daily Inflow (CFS)
114, May 22

Peak Daily Outflow (CFS)
42, May 28

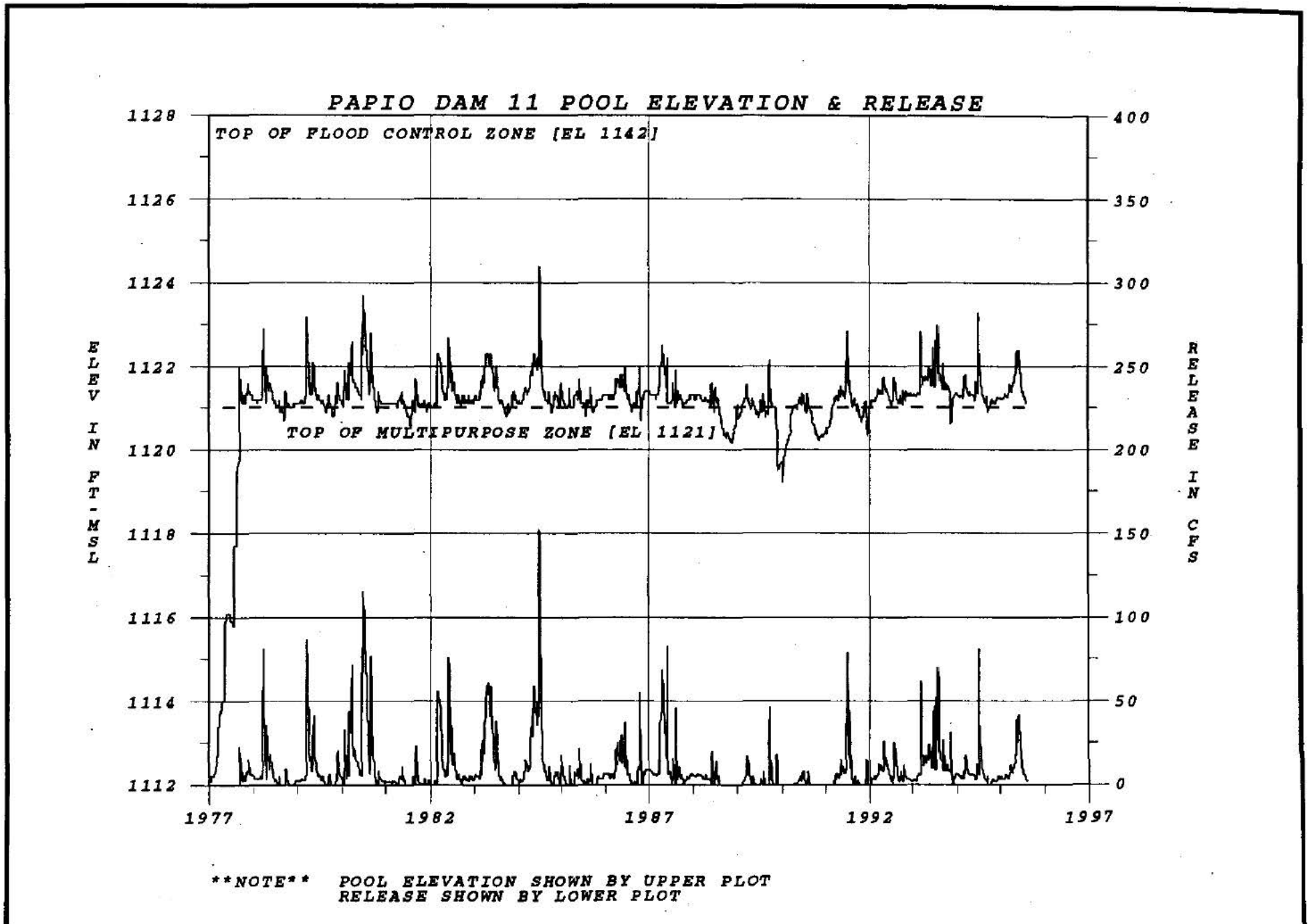
Peak Pool Elevation (Feet msl)
1122.40, May 27

Minimum Pool Elevation (Feet msl)
1120.91, Sep 20

PAPIO DAM 11 POOL ELEVATION & RELEASE



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


PAPIO DAM 11 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1142]
TOP OF MULTIPURPOSE ZONE [EL 1121]
ELEV IN FT-MSL
RELEASE IN CFS
1128
1126
1124
1122
1120
1118
1116
1114
1112
400
350
300
250
200
150
100
50
0
1977
1982
1987
1992
1997
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

STANDING BEAR DAM AND LAKE
PAPILLION CREEK BASIN - NO. 16, NEBRASKA
1994-1995 REGULATION

The pool level started the report period below the flood control zone. It remained under the flood control zone until the middle of March. During April the pool level fluctuated below the flood control zone for a short time, then re-entered the zone staying until the end of June. It remained below the flood control zone throughout the period. Heavy precipitation during April and May produced inflows of 209% and 249% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	266 cfs Jun 14 84	62 cfs Jun 16-17 84
2nd	235 cfs Aug 09 87	57 cfs Aug 09 87
3rd	211 cfs Jun 22 94	52 cfs May 22 82

	Pool-Date
Highest	1107.8 Jan 16 84
2nd	1107.5 Jun 23 94
3rd	1107.1 Aug 08 87

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1095.9 Feb 28 91
2nd	1097.6 May 22 90

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
1035, 91% of normal

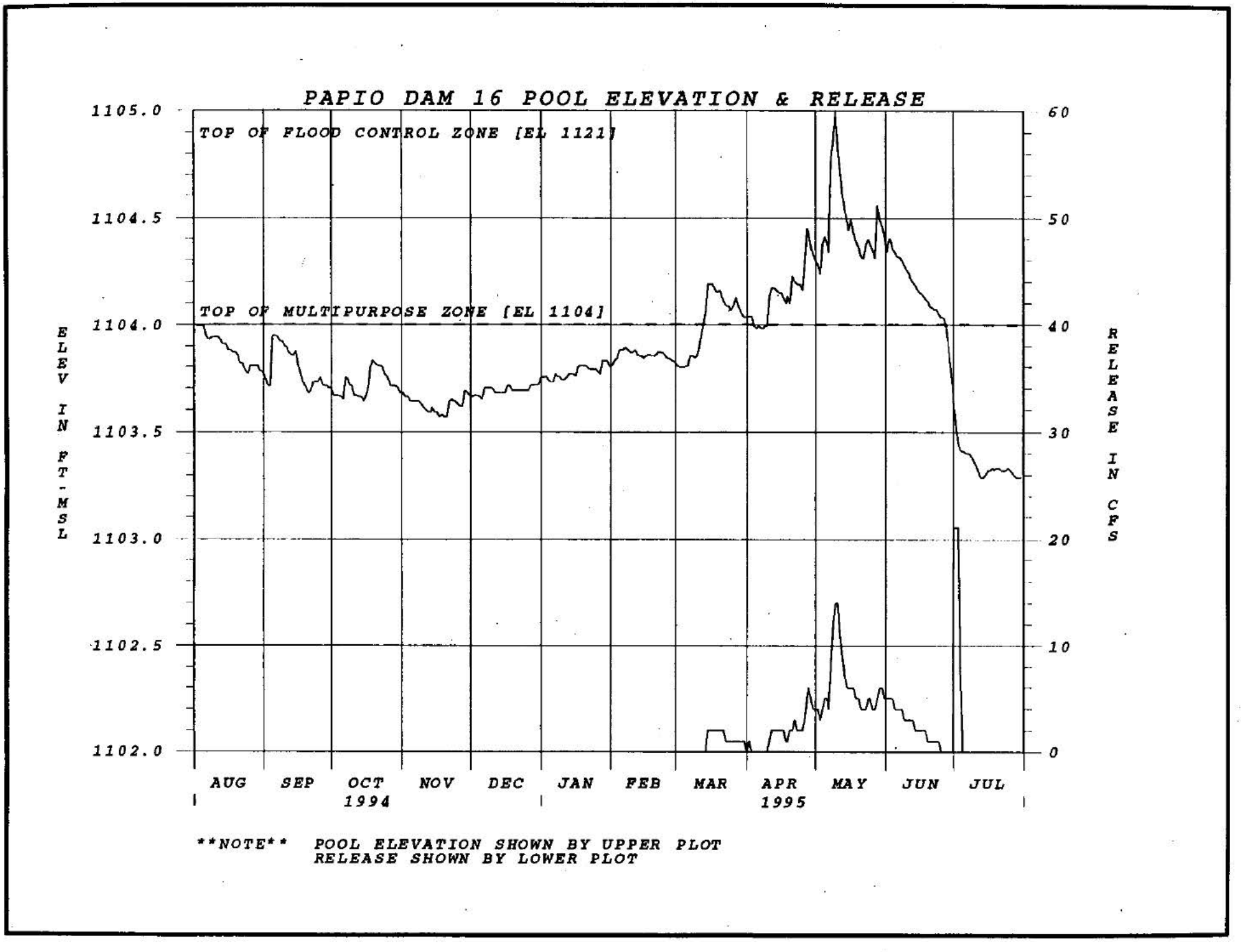
Total Outflow (AF)
760, 121% of normal

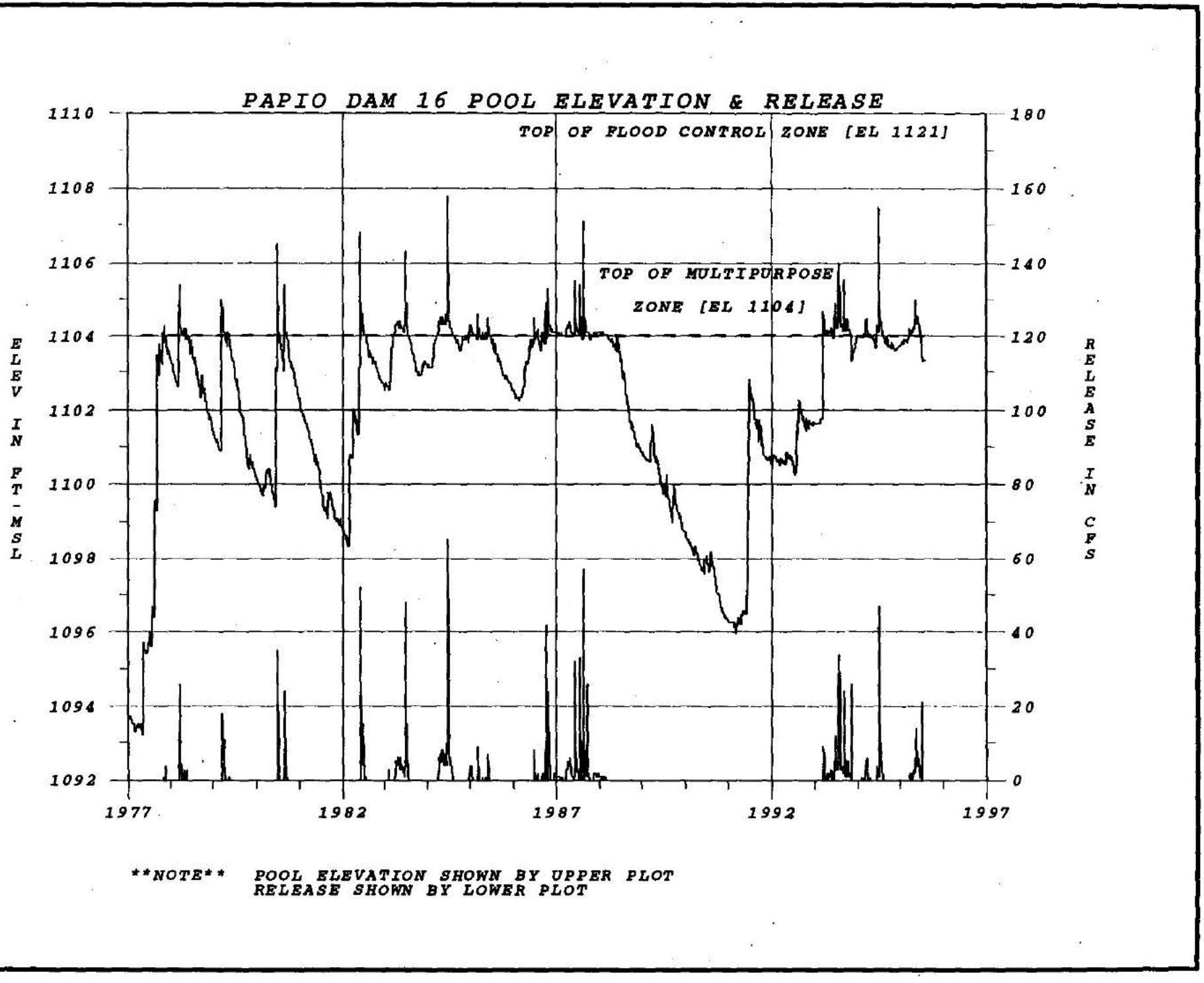
Peak Daily Inflow (CFS)
37, May 07

Peak Daily Outflow (CFS)
14, May 09

Peak Pool Elevation (Feet msl)
1104.99, May 09

Minimum Pool Elevation (Feet msl)
1103.29, Jul 12


PAPIO DAM 16 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1121]
TOP OF MULTIPURPOSE ZONE [EL 1104]
ELEV IN FT-MSL
RELEASE IN CFS
1105.0
1104.5
1104.0
1103.5
1103.0
1102.5
1102.0
60
50
40
30
20
10
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


PAPIO DAM 16 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1121]
TOP OF MULTIPURPOSE ZONE [EL 1104]
ELEV IN FT-MSL
RELEASE IN CFS
1110
1108
1106
1104
1102
1100
1098
1096
1094
1092
180
160
140
120
100
80
60
40
20
0
1977
1982
1987
1992
1997
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

ZORINSKY DAM AND LAKE
PAPILLION CREEK BASIN - NO. 18, NEBRASKA
1994-1995 REGULATION

The pool level remained in the flood control zone during the beginning of the period. It stayed in the flood control zone toward the end of July where it receded below the flood control zone and remained throughout the period. Heavy rainfall in April and May produced inflows of 228% and 329% of average, respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	561 cfs Jun 14 91	142 cfs Jul 25 93
2nd	530 cfs Jul 24 93	113 cfs Aug 31 93
3rd	423 cfs Aug 30 93	102 cfs Sep 01 93

	Pool-Date
Highest	1116.79 Jul 24 93
2nd	1114.75 Aug 30 93
3rd	1111.31 Jul 12 92

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1108.53 Nov 09 91
2nd	1109.55 Nov 05 93

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
5304, 105% of normal

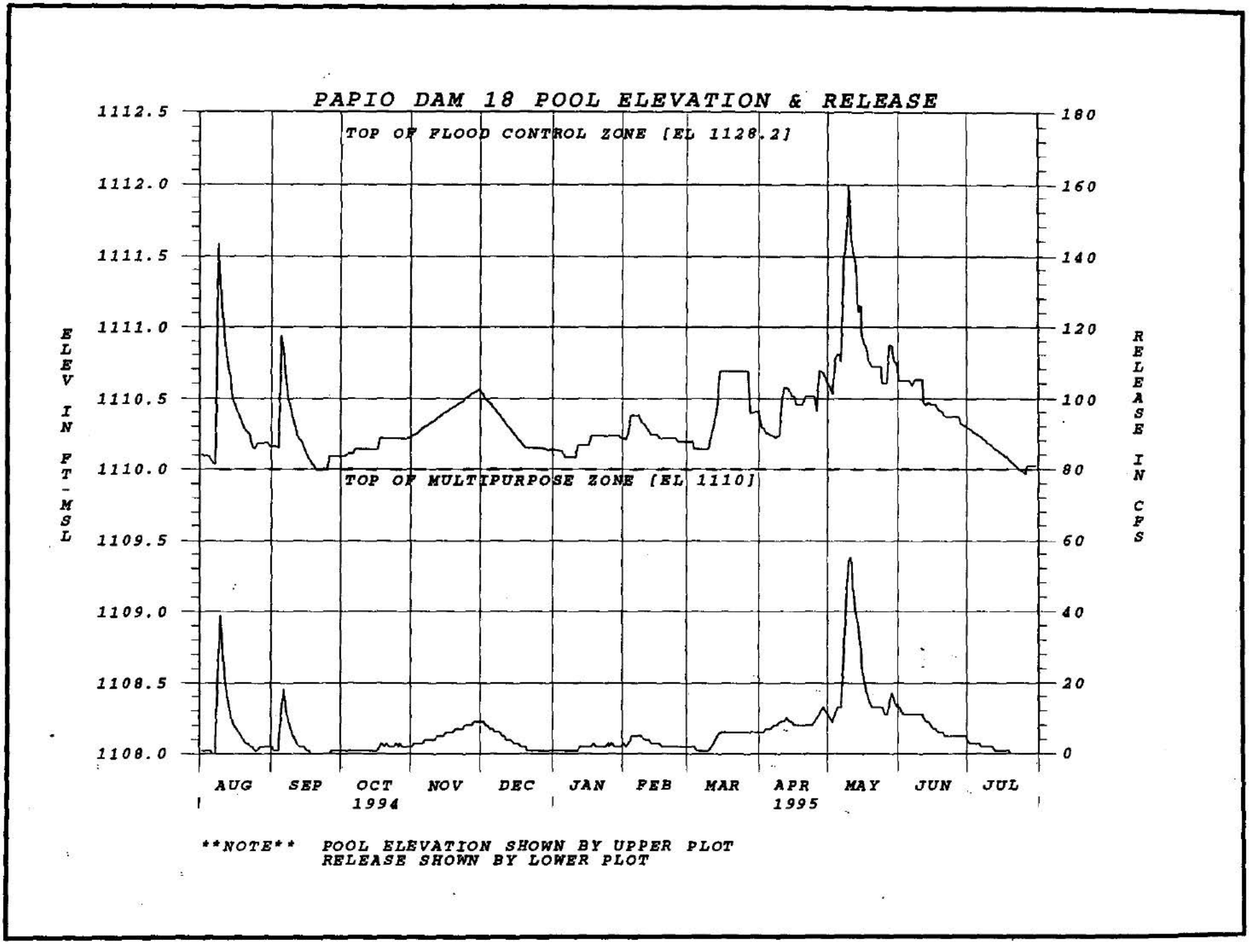
Total Outflow (AF)
4693, 115% of normal

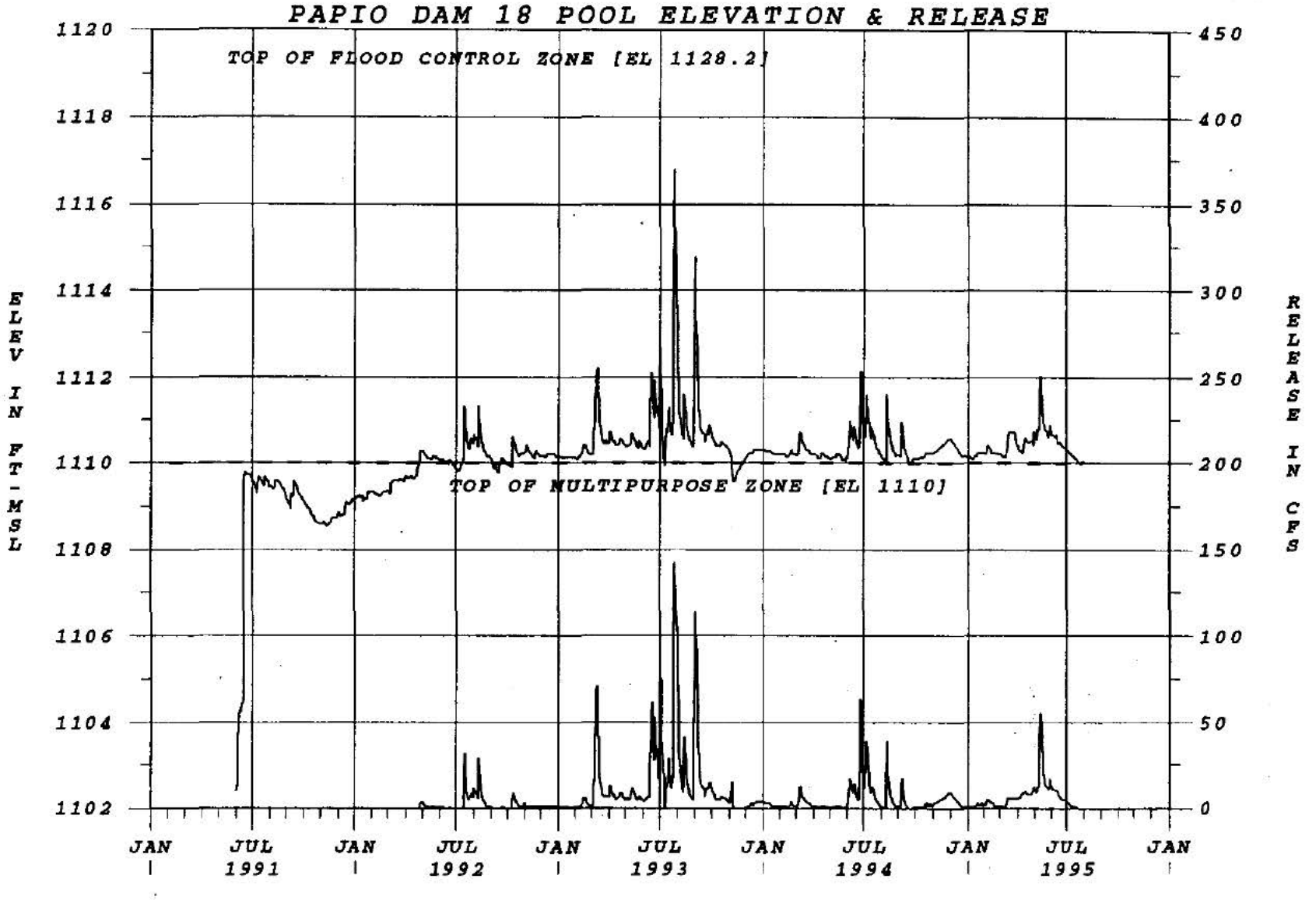
Peak Daily Inflow (CFS)
128, May 07

Peak Daily Outflow (CFS)
55, May 10

Peak Pool Elevation (Feet msl)
1112.0, May 09

Minimum Pool Elevation (Feet msl)
1109.87, Jul 31


PAPIO DAM 18 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1128.2]
TOP OF MULTIPURPOSE ZONE [EL 1110]
ELEV IN FT-MSL
RELEASE IN CFS
1112.5
1112.0
1111.5
1111.0
1110.5
1110.0
1109.5
1109.0
1108.5
1108.0
180
160
140
120
100
80
60
40
20
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

WEHRSPAN DAM AND LAKE
PAPILLION CREEK BASIN - NO. 20, NEBRASKA
1994-1995 REGULATION

The pool level remained in the flood control zone during the beginning of the period. It receded below the flood control zone in September, fluctuating above and below. The pool level stayed below the flood control zone until April. Re-entered the flood control zone and remained up to July then receded below the flood control zone throughout the period. Heavy rainfall (5.32 and 7.41 inches) caused high rises within the pool level during April and May producing inflows of 359% and 437% of average, respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	515 cfs Aug 25 87	124 cfs Jul 25 93
2nd	485 cfs Jul 22 93	101 cfs Aug 31 93
3rd	458 cfs Aug 29 93	77 cfs Aug 26 87

	Pool-Date
Highest	1103.20 Jul 24 93
2nd	1101.14 Aug 30 93
3rd	1099.5 Aug 25 87

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1085.4 May 02 90
2nd	1085.9 Feb 02 91

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
2524, 112% of normal

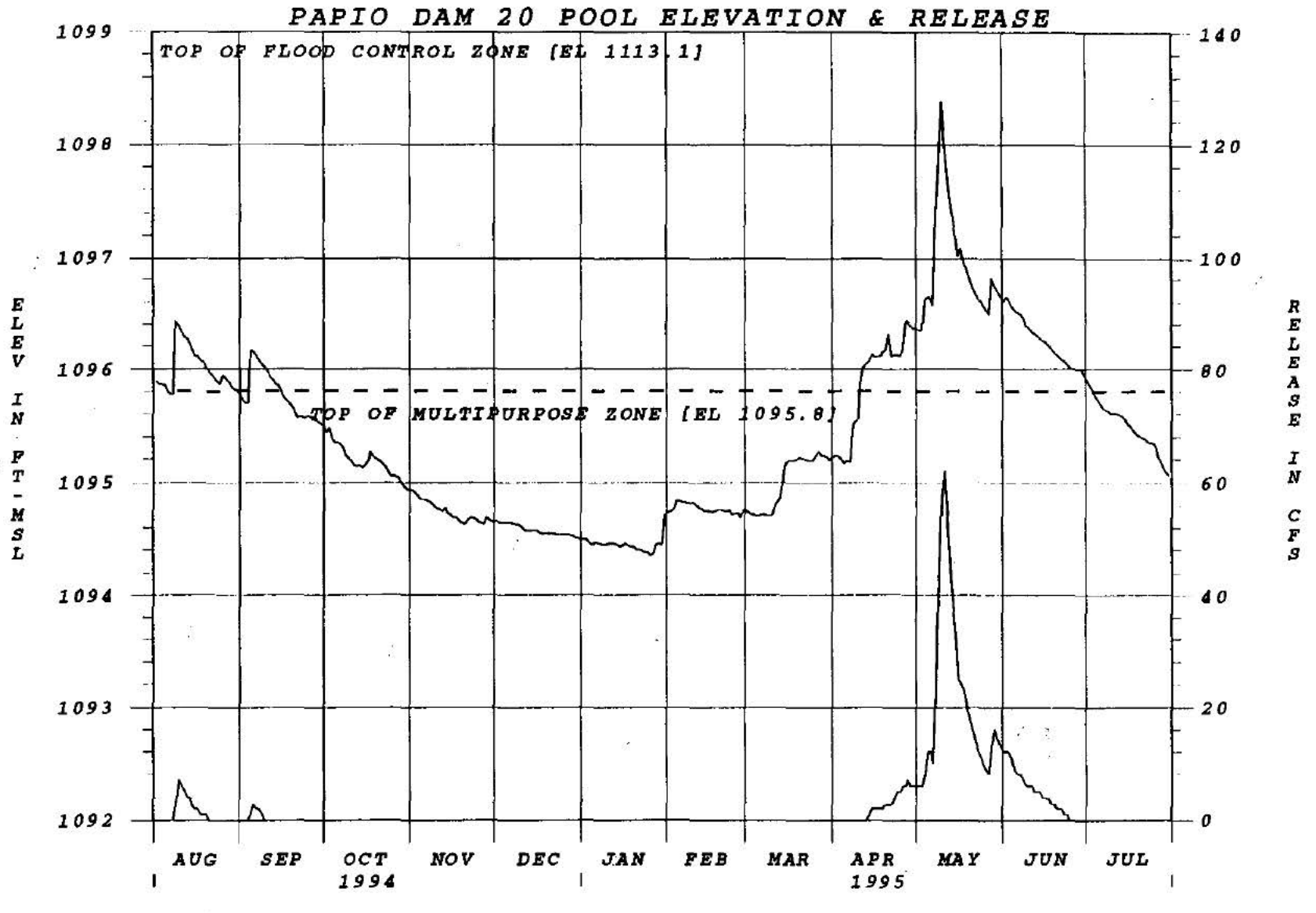
Total Outflow (AF)
1801, 134% of normal

Peak Daily Inflow (CFS)
143, May 09

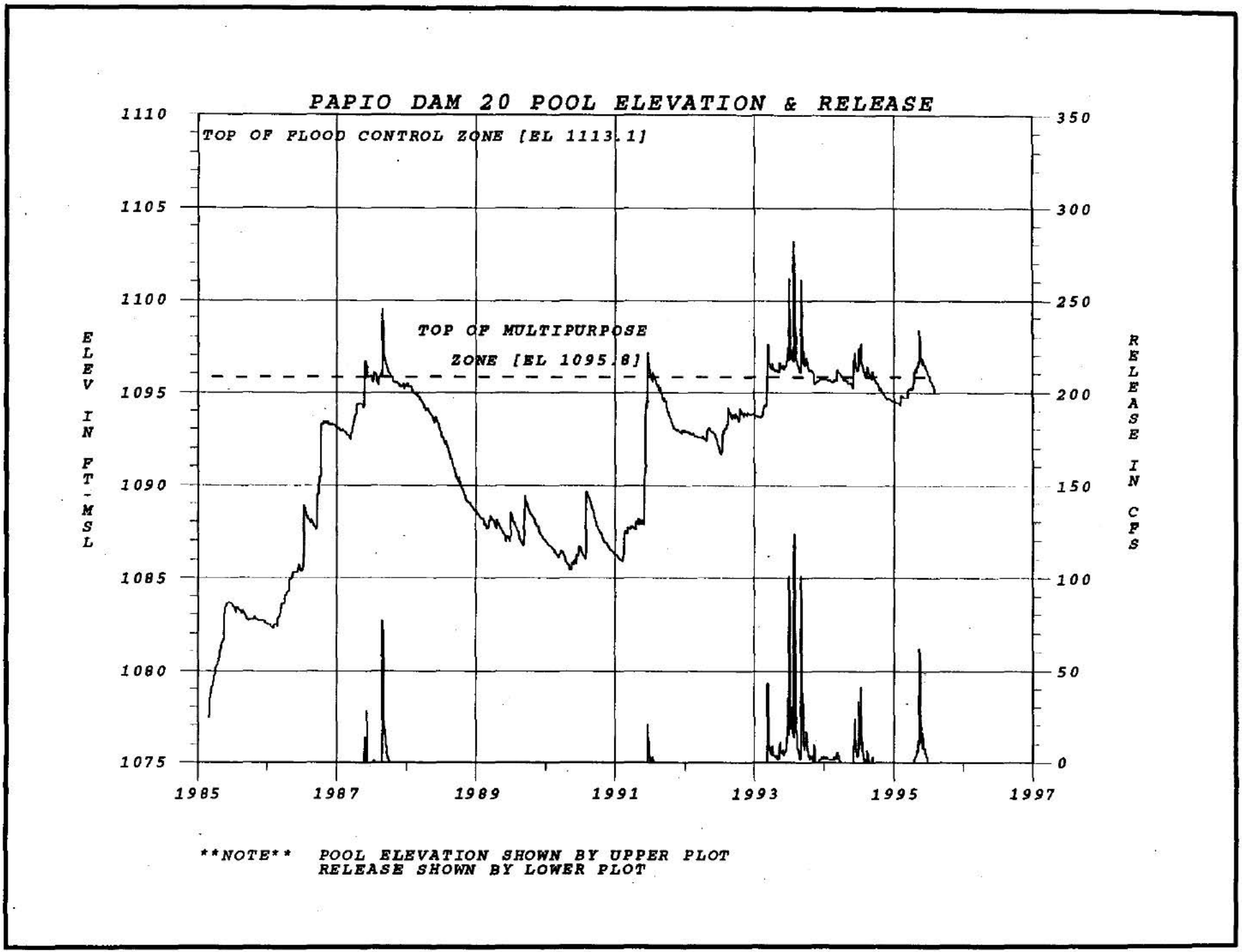
Peak Daily Outflow (CFS)
62, May 10

Peak Pool Elevation (Feet msl)
1098.39, May 09

Minimum Pool Elevation (Feet msl)
1094.35, Jan 25



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


PAPIO DAM 20 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1113.1]
TOP OF MULTIPURPOSE
ZONE [EL 1095.8]
ELEV IN FT-MSL
RELEASE IN CFS
1110
1105
1100
1095
1090
1085
1080
1075
350
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

PIPESTEM DAM AND LAKE
PIPESTEM CREEK, JAMES RIVER BASIN, NORTH DAKOTA
1994-1995 REGULATION

A substantial winter snowpack and summer rainfall produced the highest volume of inflow for this report period since the dam was closed in 1974. The highest discharge of record was made June through August when a release of 600 cfs was made.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	4,374 cfs Jul 15 93	616 cfs Jun 16 95
2nd	3,380 cfs Apr 20 75	568 cfs Oct 27; Nov 02 93
3rd	3,000 cfs Apr 18 79	310 cfs Oct 22-26, 31; Nov 01 75

	Pool-Date
Highest	1479.54 May 22 95
2nd	1472.64 Aug 14 93
3rd	1468.35 May 10 79

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1439.97 Jan 01 77
2nd	1439.65 Feb 18 93
3rd	1440.11 Jul 31 92

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
145,352, 437% of normal

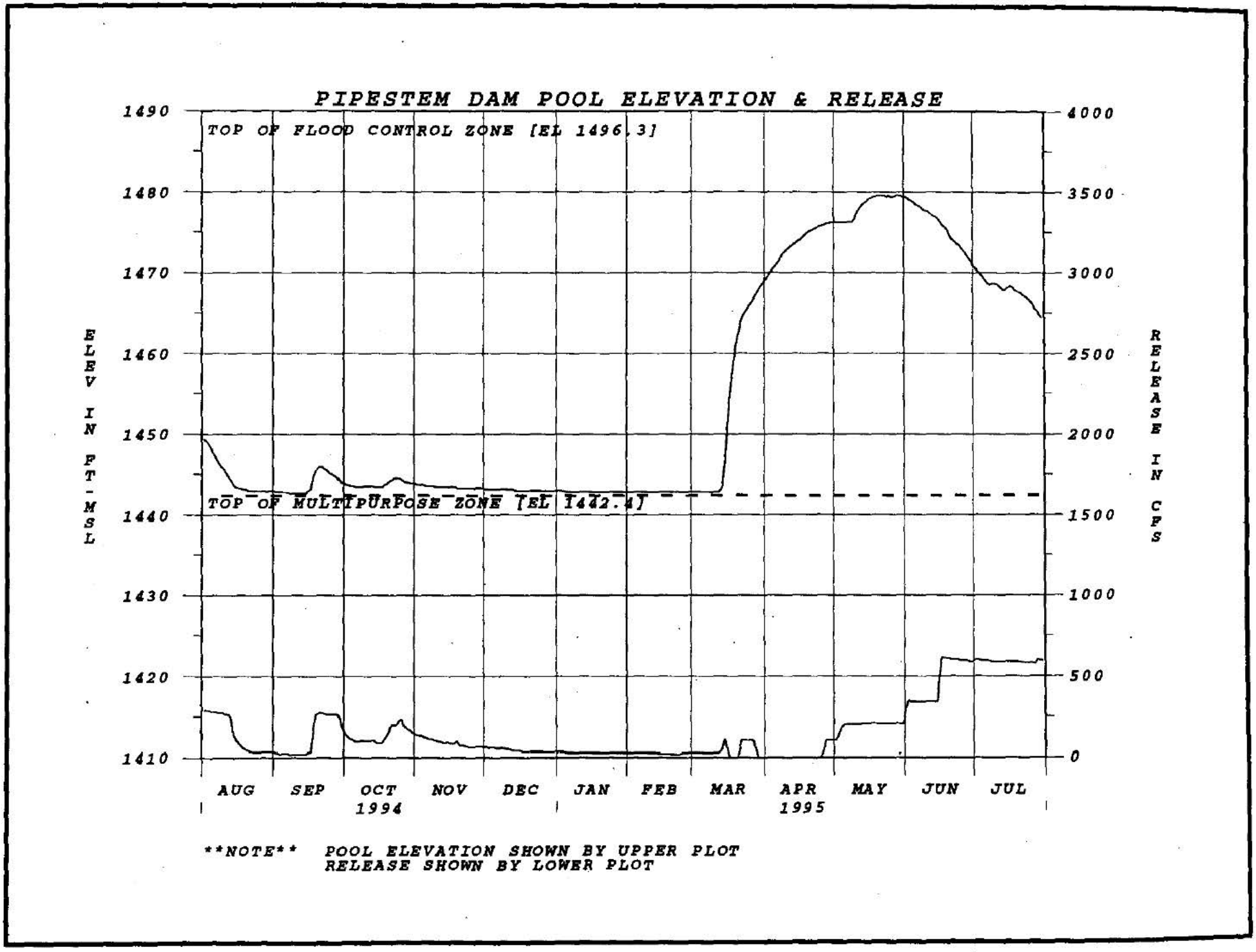
Total Outflow (AF)
117,671, 417% of normal

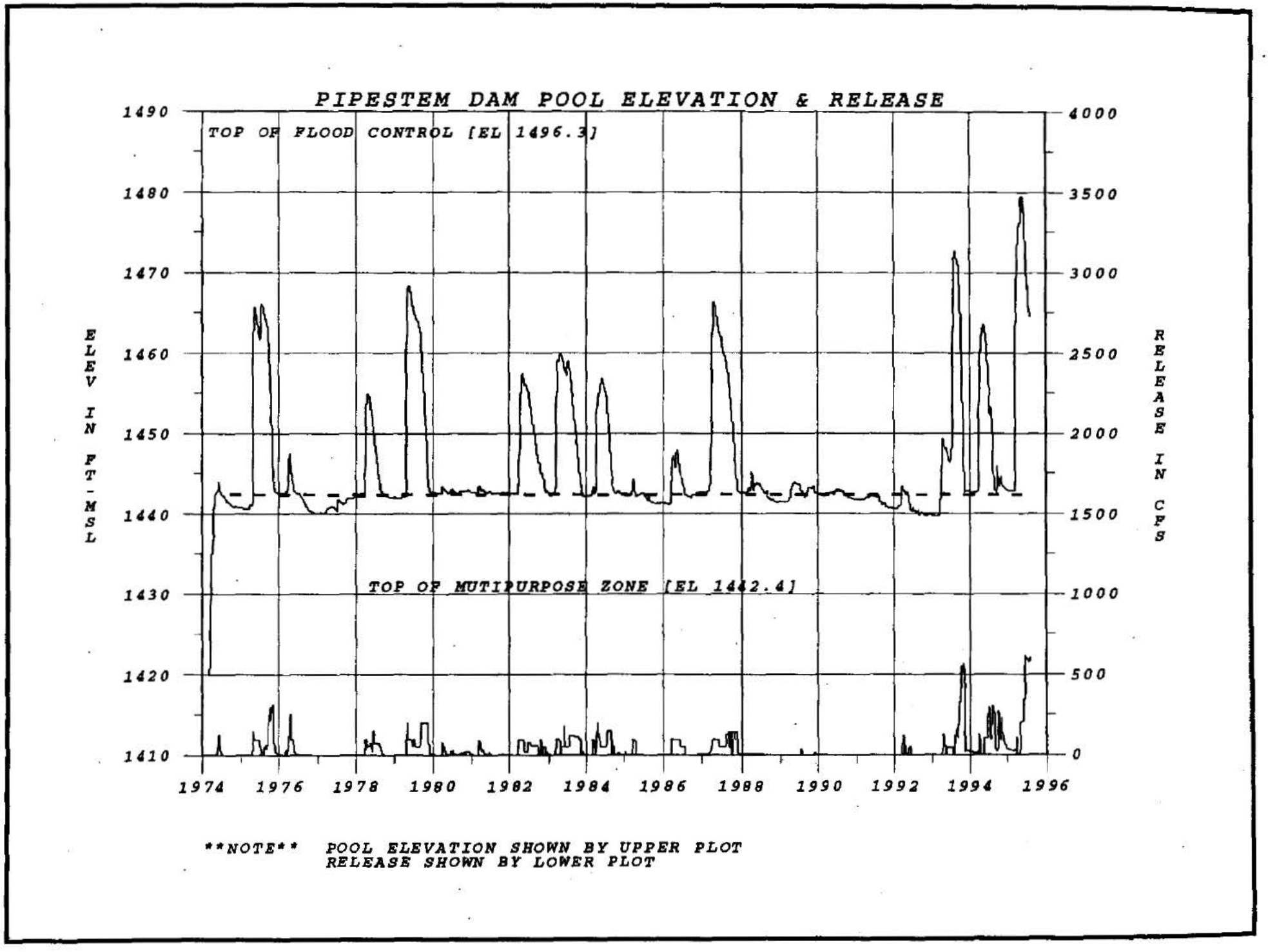
Peak Daily Inflow (CFS)
2938, Mar 16

Peak Daily Outflow (CFS)
616, Jun 16

Peak Pool Elevation (Feet msl)
1479.54, May 22

Minimum Pool Elevation (Feet msl)
1442.72, Sep 14


PIPESTEM DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1496.3]
TOP OF MULTIPURPOSE ZONE [EL 1442.4]
ELEV IN FT-MSL
RELEASE IN CFS
1490
1480
1470
1460
1450
1440
1430
1420
1410
4000
3500
3000
2500
2000
1500
1000
500
0
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

OLIVE CREEK DAM AND LAKE
SALT CREEK BASIN - NO. 2, NEBRASKA
1994-1995 REGULATION

During the reporting period the pool level entered the flood control zone toward the end of August for a brief time. It receded below the flood control zone in the middle of September. The pool level re-entered the flood control zone in the middle of April and stayed until the later part of July then receded below the flood control zone and stayed. Heavy rainfall in April and May (3.45 inches and 9.29 at the damsite) produced inflows of 139% and 820% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	764 cfs Jun 12 84	179 cfs Jul 25 93
2nd	749 cfs oct 10 73	176 cfs Oct 12 73
3rd	730 cfs Oct 11 86	171 cfs Jun 13 84

	Pool-Date
Highest	1342.62 Jul 24 93
2nd	1342.6 Oct 11 73
3rd	1342.6 Jun 12 84

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1326.63 Oct 28 91
2nd	1326.31 Jul 04 92

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
4634, 196% of normal

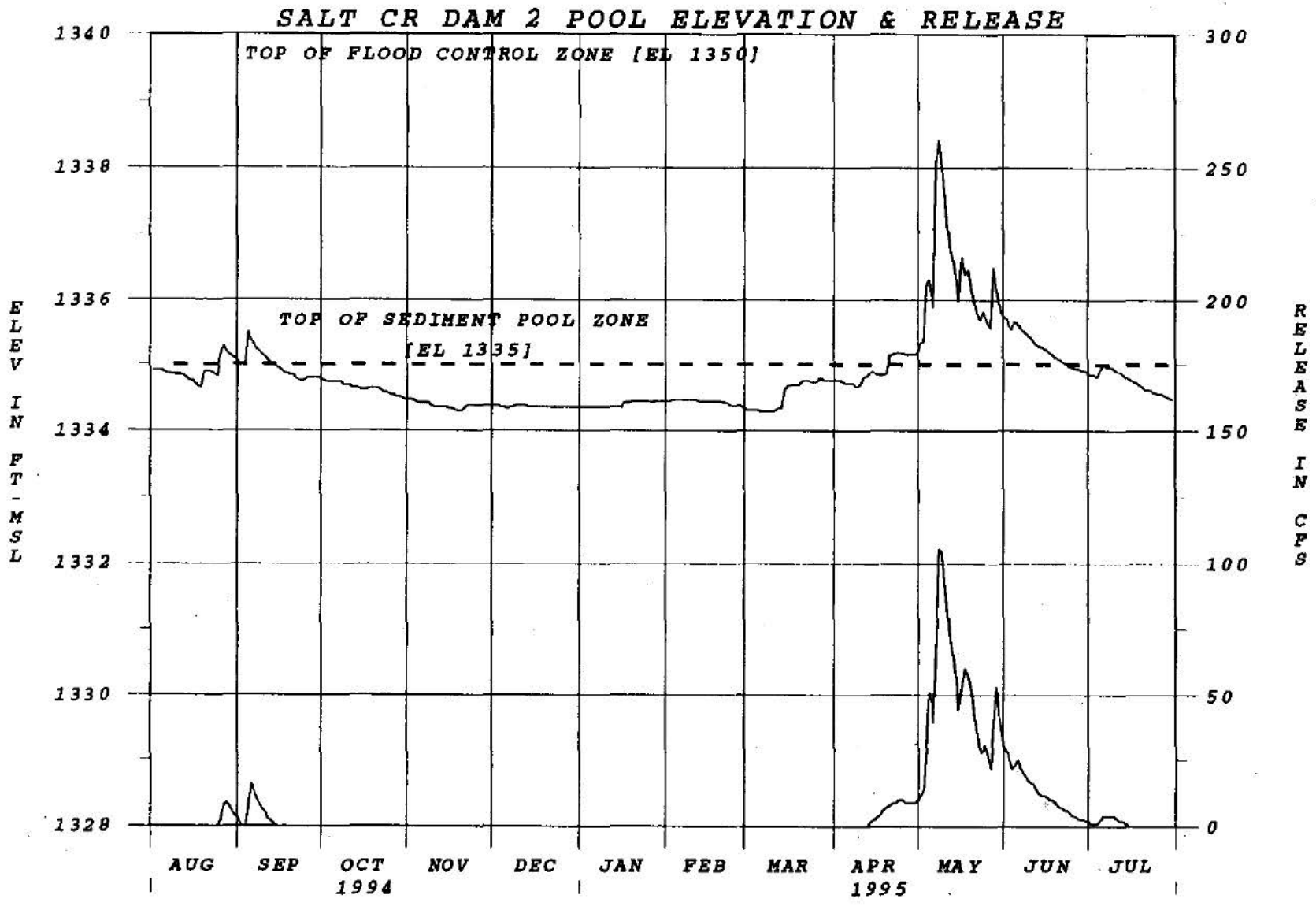
Total Outflow (AF)
4252, 245% of normal

Peak Daily Inflow (CFS)
285, May 07

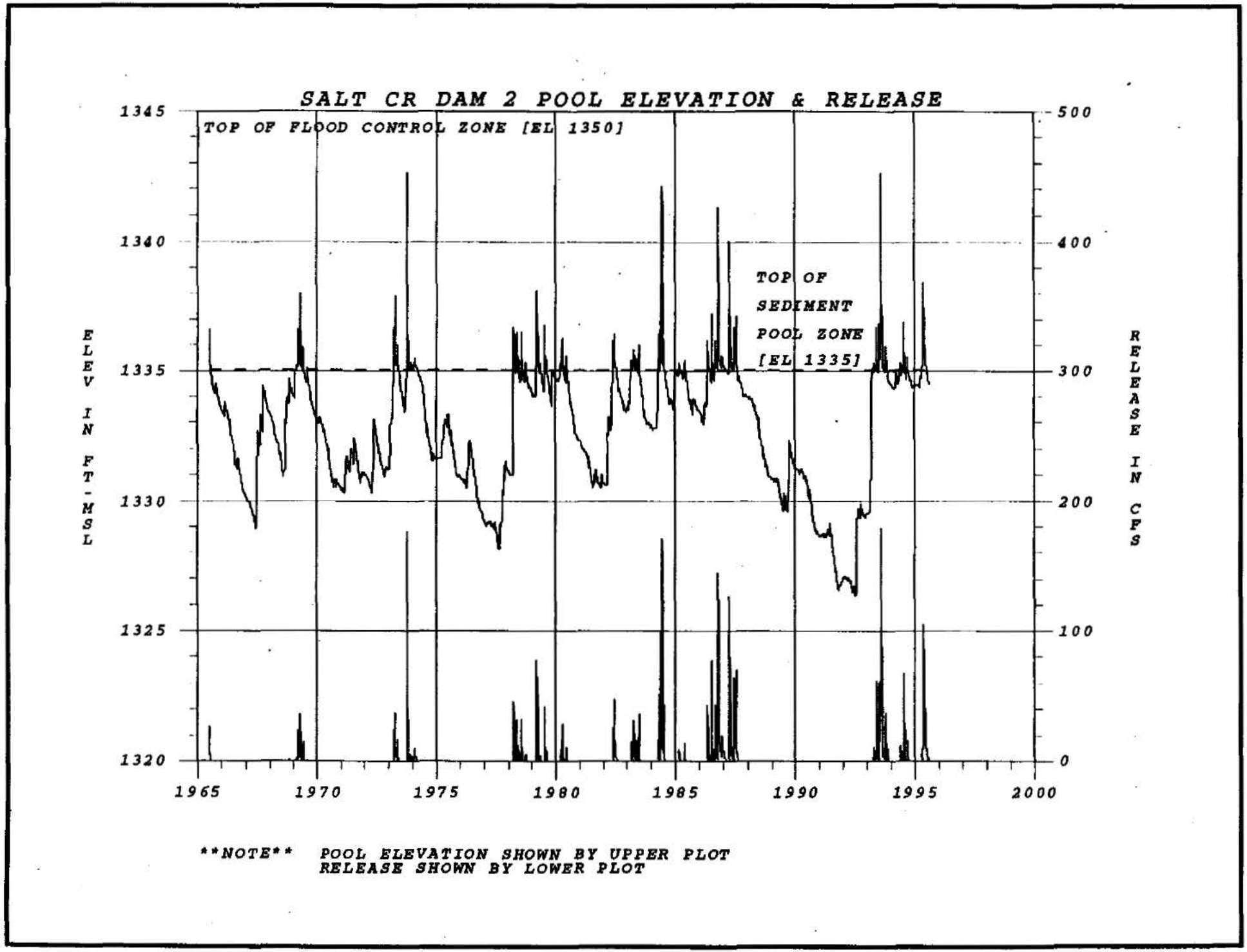
Peak Daily Outflow (CFS)
105, May 08

Peak Pool Elevation (Feet msl)
1338.42, May 08

Minimum Pool Elevation (Feet msl)
1334.30, Nov 18



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 2 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1350]
TOP OF SEDIMENT POOL ZONE [EL 1335]
ELEV IN FT-MSL
RELEASE IN CFS
1345
1340
1335
1330
1325
1320
500
400
300
200
100
0
1965
1970
1975
1980
1985
1990
1995
2000
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

BLUESTEM DAM AND LAKE
SALT CREEK BASIN - NO. 4, NEBRASKA
1994-1995 REGULATION

The pool level started the report period in the flood control zone, but receded below the flood control zone during the middle of the month for a brief period. The pool level continued fluctuating above and below the flood control zone throughout the reporting period. Heavy rainfall during April and May (5.02 and 9.29 inches) produced high rises in the pool level. Inflows to the project during those months were 163% and 692% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	1,477 cfs Oct 10 73	342 cfs Oct 12 73
2nd	932 cfs Jul 23 93	198 cfs Jun 13 84
3rd	911 cfs Oct 11 86	195 cfs Jul 26 93

	Pool-Date
Highest	1316.5 Oct 11 73
2nd	1314.5 Jun 13 84
3rd	1314.23 Jul 25 93

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1299.46 May 31 92
2nd	1299.77 Nov 13 91

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
10,408, 235% of normal

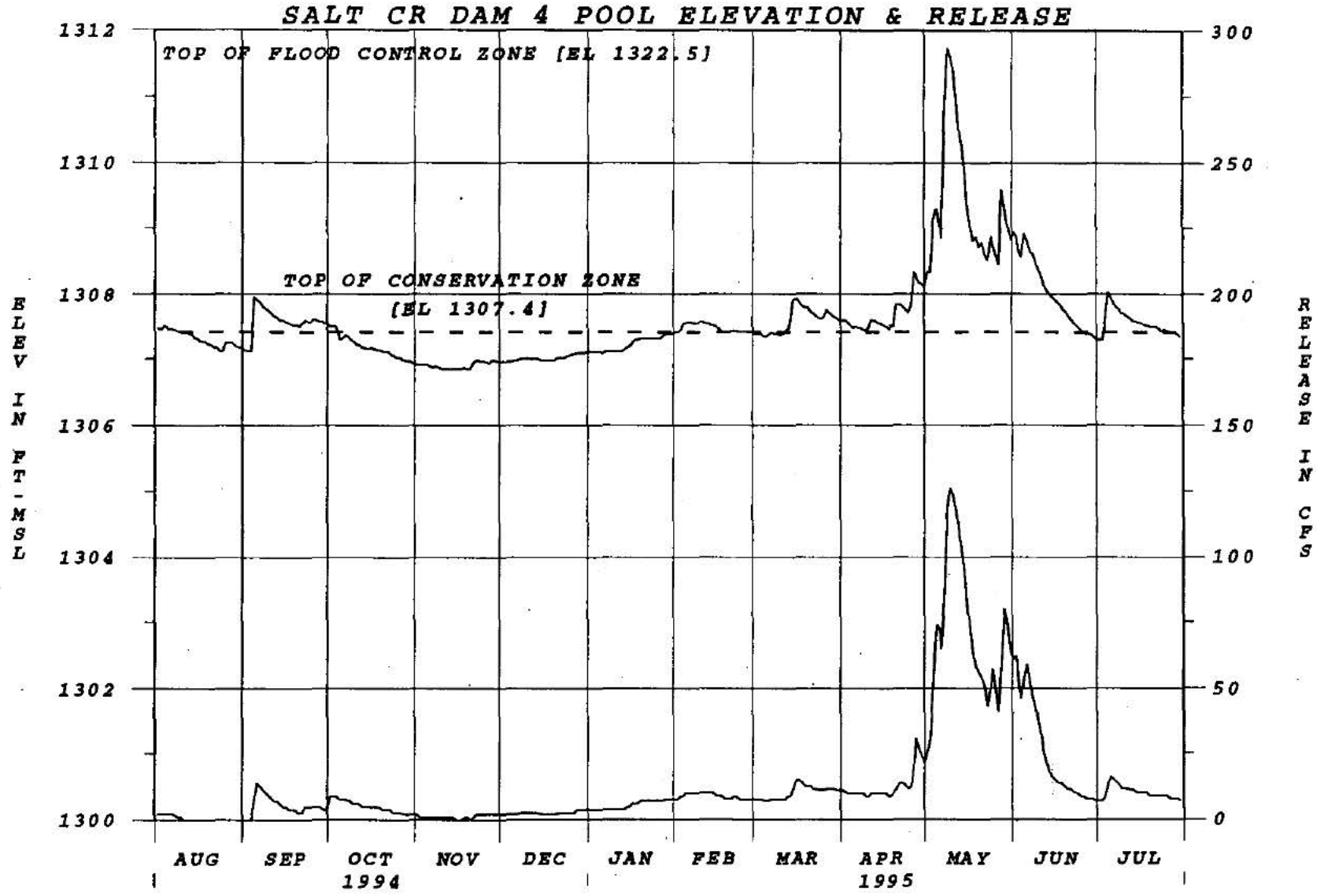
Total Outflow (AF)
9,613, 297% of normal

Peak Daily Inflow (CFS)
424, May 07

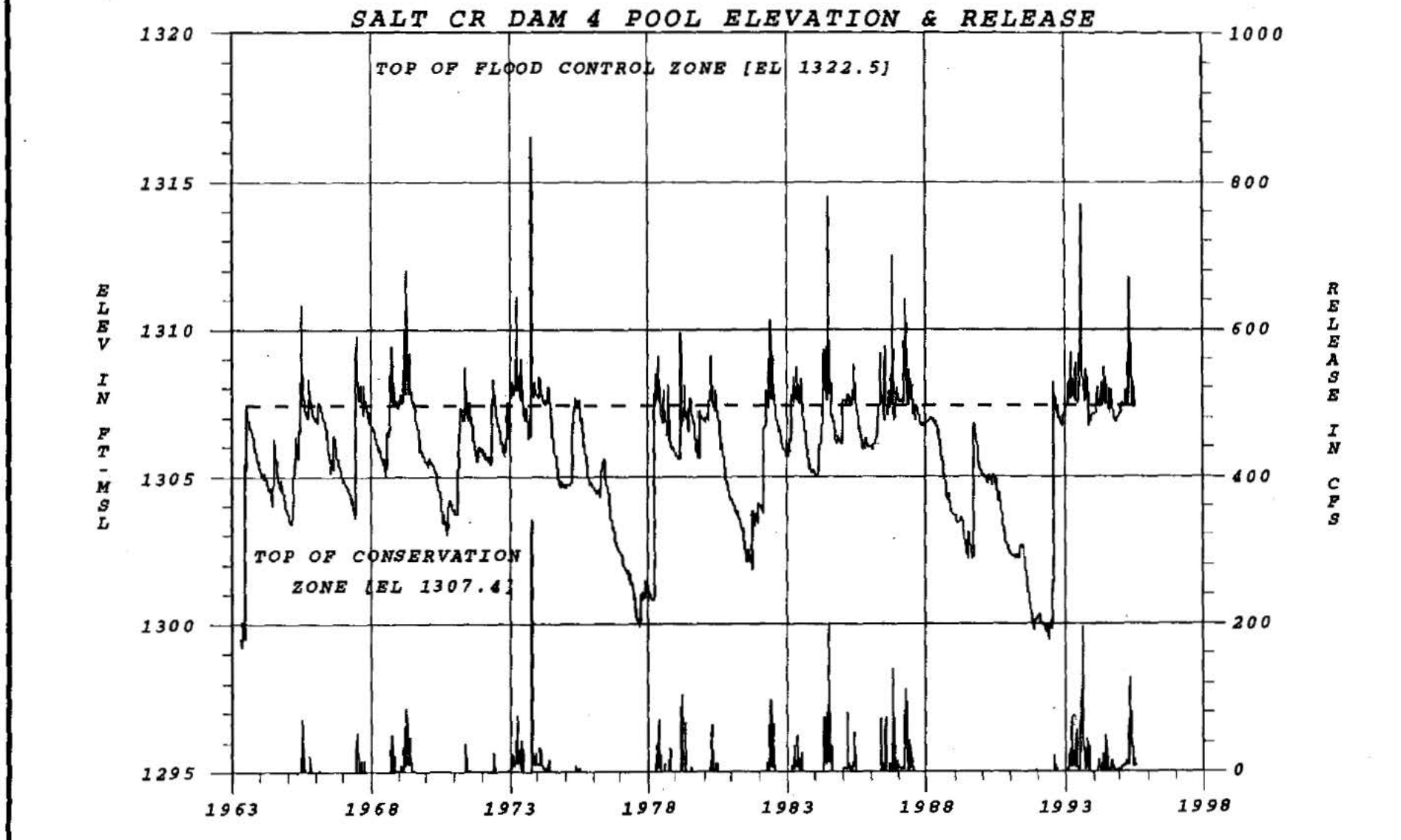
Peak Daily Outflow (CFS)
126, May 09

Peak Pool Elevation (Feet msl)
1311.74, May 08

Minimum Pool Elevation (Feet msl)
1306.84, Nov 16



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

WAGON TRAIN DAM AND LAKE
SALT CREEK BASIN - NO. 8, NEBRASKA
1994-1995 REGULATION

The pool level fluctuated above and below the flood control zone during the reporting period. Some months more above then below. High increase in the pool level occurred during the months of April and May due to heavy precipitation. Inflows to the project during those months were 162% and 702% of average, respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	1,199 cfs Oct 10 73	334 cfs Jul 25 93
2nd	1,037 cfs Jul 24 93	329 cfs Oct 12 73
3rd	1,027 cfs Oct 11 86	175 cfs Oct 12 86

	Pool-Date
Highest	1295.4 Oct 11 73
2nd	1294.61 Jul 25 93
3rd	1293.2 Jun 13 84
	Oct 11 86

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1281.72 Nov 01 91
2nd	1282.2 Nov 28 75

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
8345, 184% of normal

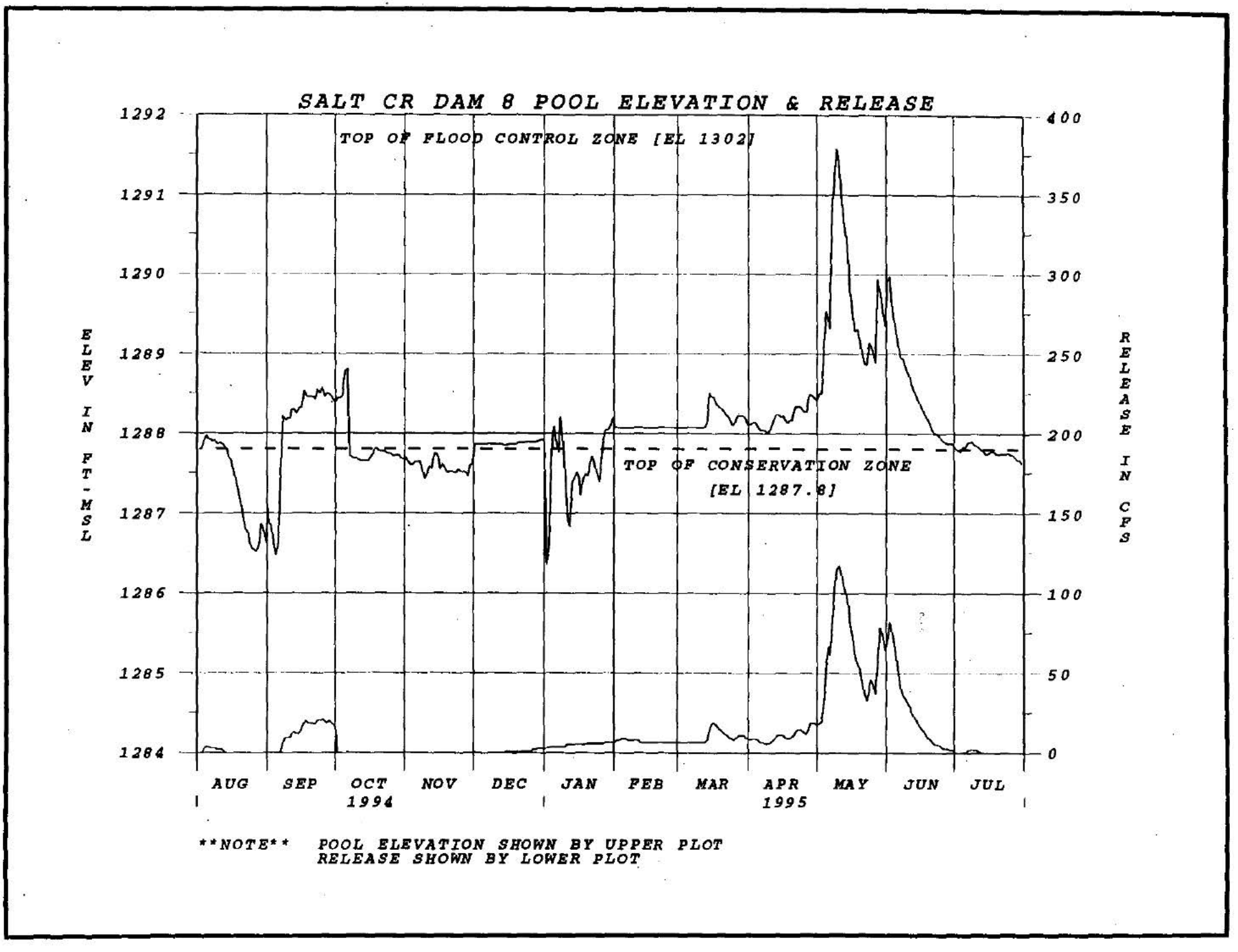
Total Outflow (AF)
7620, 221% of normal

Peak Daily Inflow (CFS)
356, May 08

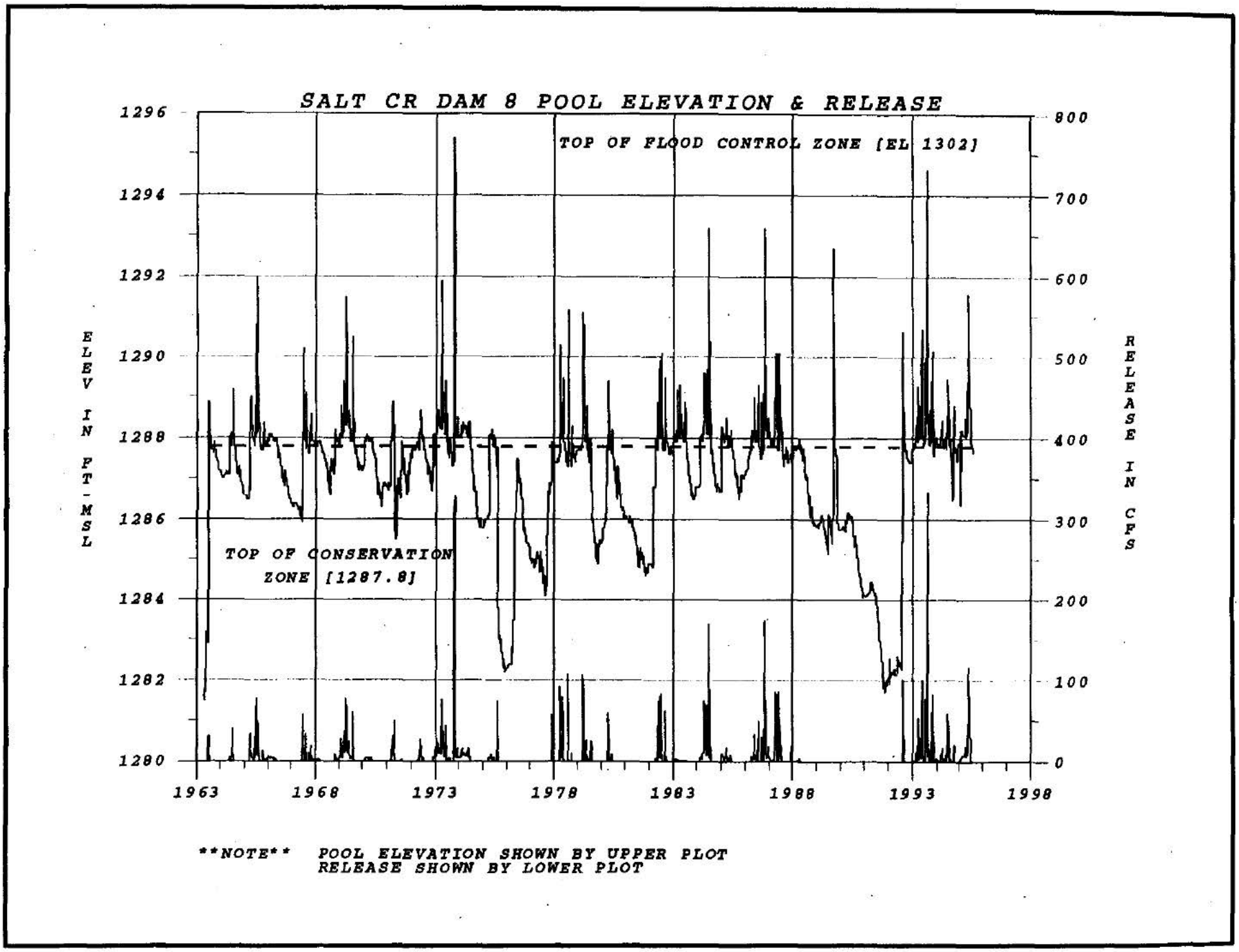
Peak Daily Outflow (CFS)
117, May 10

Peak Pool Elevation (Feet msl)
1291.57, May 09

Minimum Pool Elevation (Feet msl)
1287.62, Sep 21



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 8 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1302]
TOP OF CONSERVATION ZONE [1287.8]
ELEV IN FT-MSL
RELEASE IN CFS
1296
1294
1292
1290
1288
1286
1284
1282
1280
800
700
600
500
400
300
200
100
0
1963
1968
1973
1978
1983
1988
1993
1998
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

STAGECOACH DAM AND LAKE
SALT CREEK BASIN - NO. 9, NEBRASKA
1994-1995 REGULATION

The pool level fluctuated above and below the flood control zone during the reporting period. It remained above the flood control zone most of the period except for brief spots during the months of September, October, November and July. Significant rises occurred in the pool level during April and May from heavy rainfall. Inflows to the project during those months were 189% and 777% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	958 cfs Oct 10 73	190 cfs Oct 12 73
2nd	829 cfs Oct 11 86	155 cfs Jul 25 93
3rd	776 cfs Jul 24 93	116 cfs oct 12 86

	Pool-Date
Highest	1279.0 Oct 11 73
2nd	1278.15 Jul 24 93
3rd	1277.4 Oct 11 86

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1259.60 Oct 31 91
2nd	1260.5 Aug 09 76

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
6336, 214% of normal

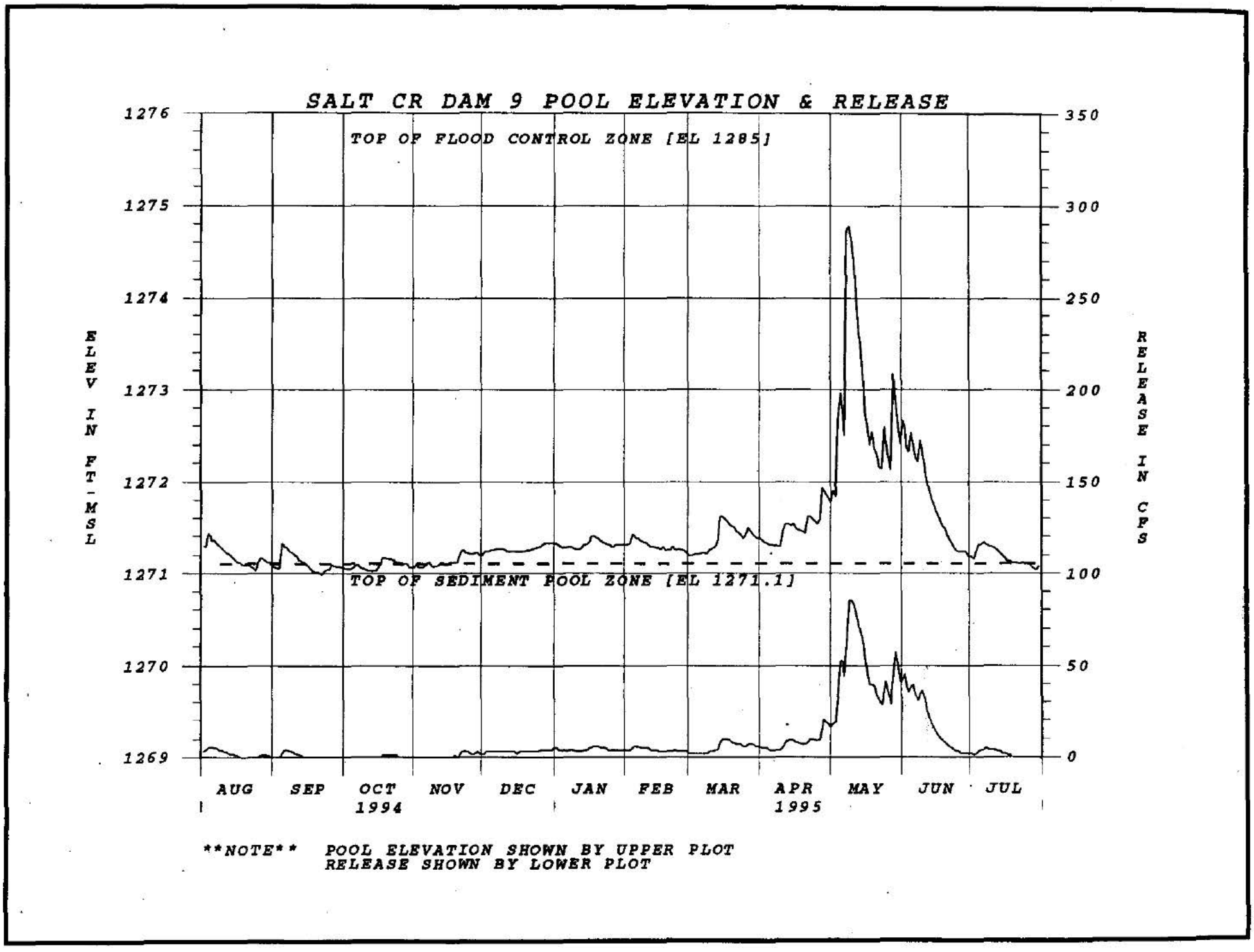
Total Outflow (AF)
5879, 265% of normal

Peak Daily Inflow (CFS)
337, May 07

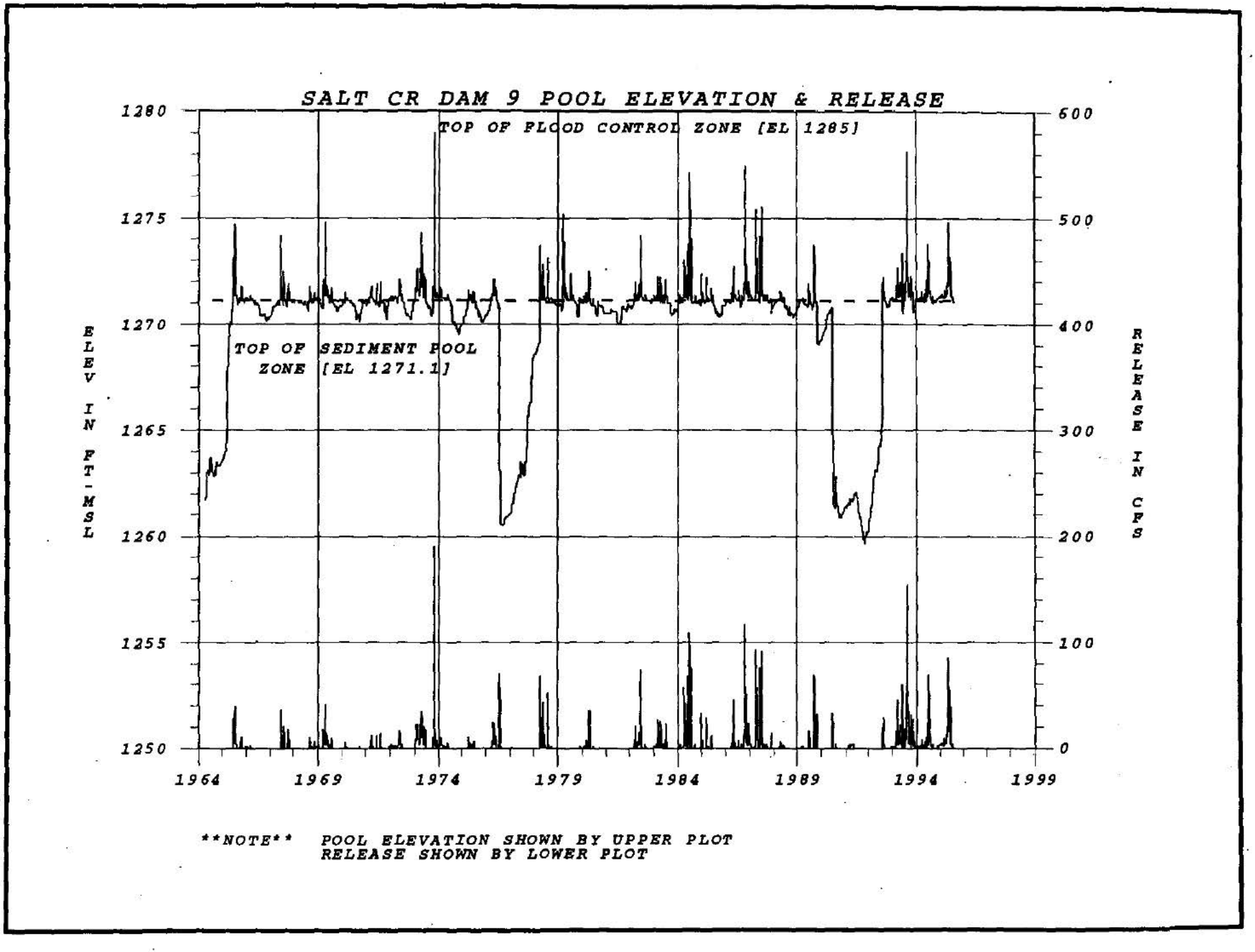
Peak Daily Outflow (CFS)
85, May 08

Peak Pool Elevation (Feet msl)
1274.77, May 08

Minimum Pool Elevation (Feet msl)
1270.99, Sep 21



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 9 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1285]
TOP OF SEDIMENT POOL ZONE [EL 1271.1]
ELEV IN FT-MSL
RELEASE IN CFS
1280
1275
1270
1265
1260
1255
1250
600
500
400
300
200
100
0
1964
1969
1974
1979
1984
1989
1994
1999
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

YANKEE HILL DAM AND LAKE
SALT CREEK BASIN - NO. 10, NEBRASKA
1994-1995 REGULATION

The pool level started the report period in the flood control zone, but slowly declining below the flood control zone during the beginning of August. It stayed below the flood control zone until the middle of March then re-entered the flood control zone until June. It fell below the flood control zone fluctuating above and below until the end of the period.

Runoff and heavy precipitation during March through May caused high rises within the pool level. Inflows during April and May were 205% and 405% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	690 cfs Oct 10 73	145 cfs Oct 12 73
2nd	609 cfs Jul 24 93	133 cfs Jul 25 93
3rd	575 cfs Sep 08 89	114 cfs Jun 14 84

	Pool-Date
Highest	1252.3 Oct 11 73
2nd	1251.21 Jul 24 93
3rd	1250.7 Jun 13 84

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1238.9 Aug 08 77
2nd	1239.1 Sep 19 81

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
7461, 142% of normal

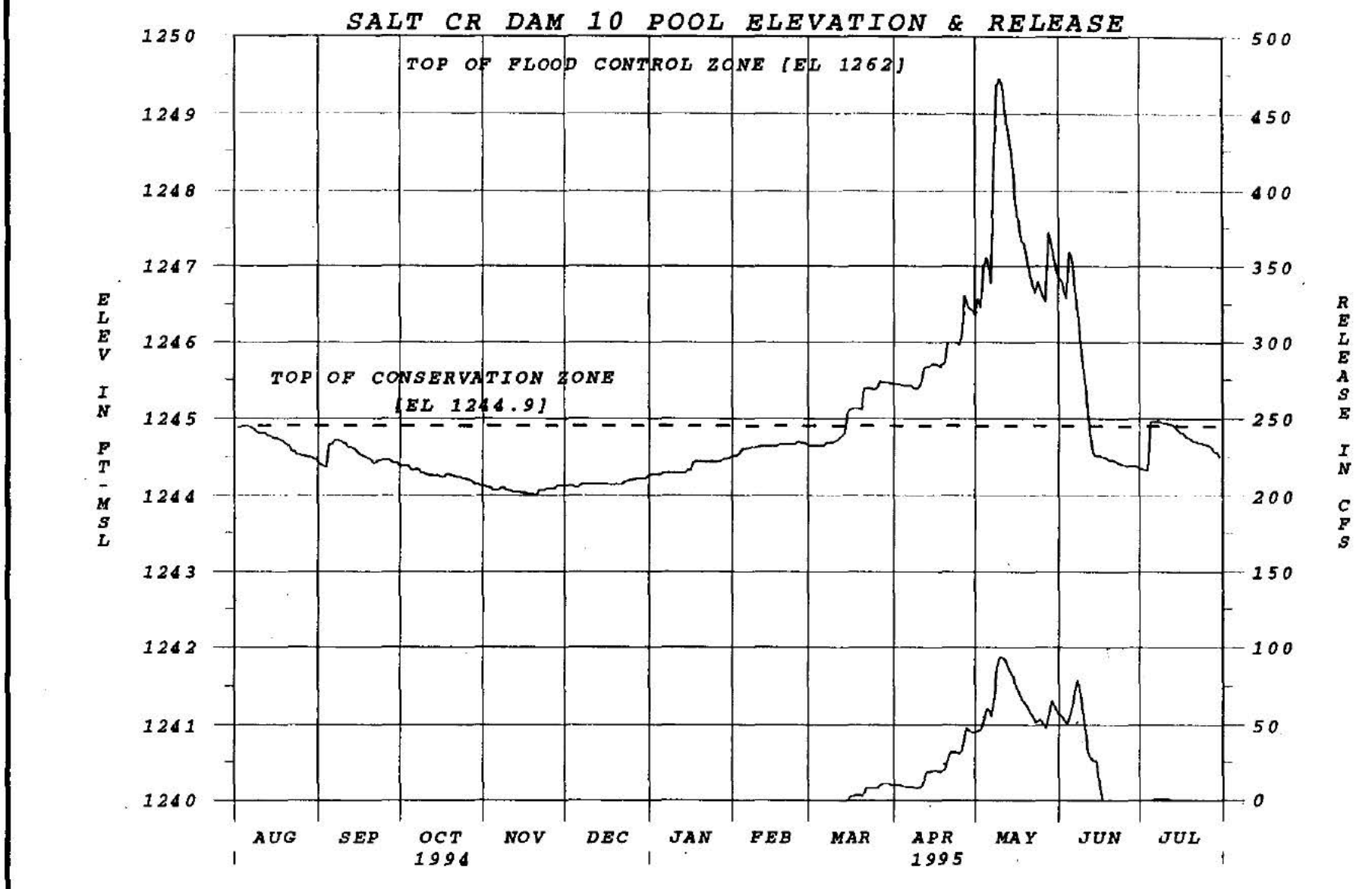
Total Outflow (AF)
6976, 157% of normal

Peak Daily Inflow (CFS)
279, May 07

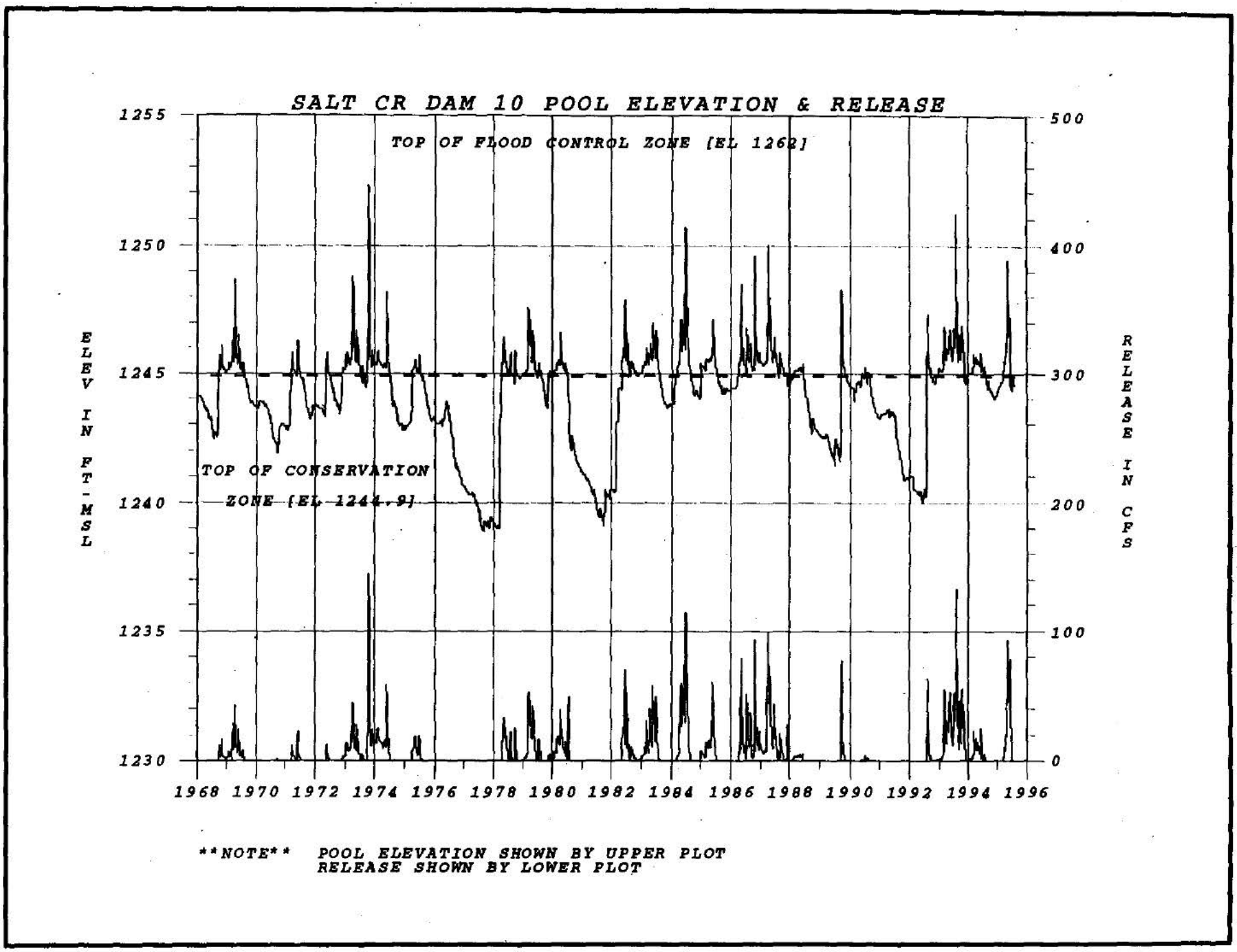
Peak Daily Outflow (CFS)
93, May 09

Peak Pool Elevation (Feet msl)
1249.46, May 09

Minimum Pool Elevation (Feet msl)
1243.99, Nov 19



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 10 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1262]
TOP OF CONSERVATION ZONE [EL 1244.9]
ELEV IN FT-MSL
RELEASE IN CFS
1255
1250
1245
1240
1235
1230
500
400
300
200
100
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

CONESTOGA DAM AND LAKE
SALT CREEK BASIN - NO. 12, NEBRASKA
1994-1995 REGULATION

The pool level remained below the flood control zone until the middle of January. It re-entered the flood control zone and stayed until mid-July and receded below the flood control zone.

Runoff and precipitation caused the pool level to enter the flood control zone in January. Heavy rainfall in April and May produce inflows of 63% and 305% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	907 cfs Mar 24 87	185 cfs Mar 25 87
2nd	899 cfs Jul 24 93	180 cfs Jul 25 93
3rd	661 cfs Jun 27 83	152 cfs Jun 16 82

	Pool-Date
Highest	1241.1 Mar 24 87
2nd	1240.63 Jul 24 93
3rd	1239.6 Oct 11 73

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1228.4 Aug 28 77
2nd	1229.12 Jun 30 92

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
4695, 81% of normal

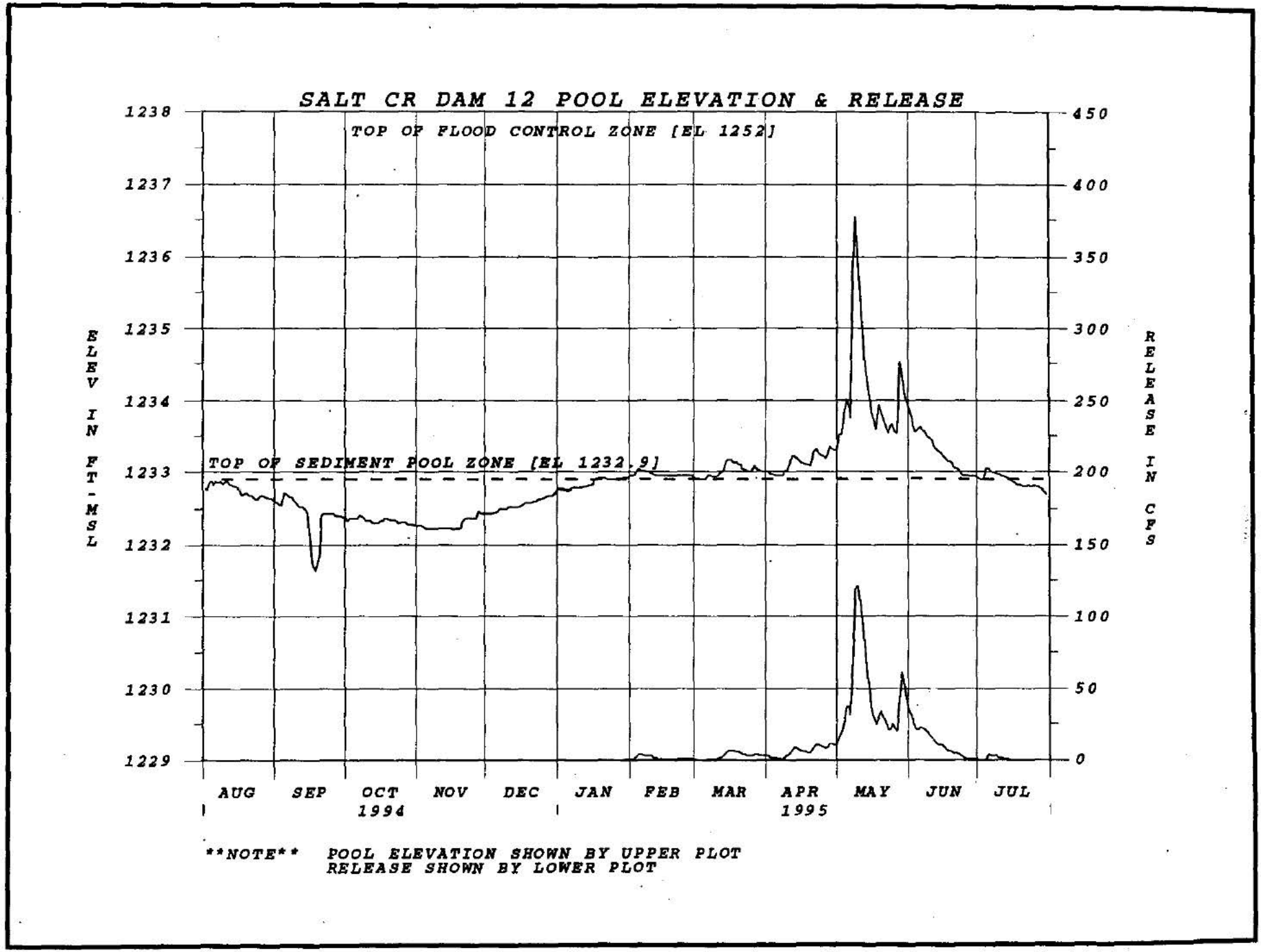
Total Outflow (AF)
4142, 82% of normal

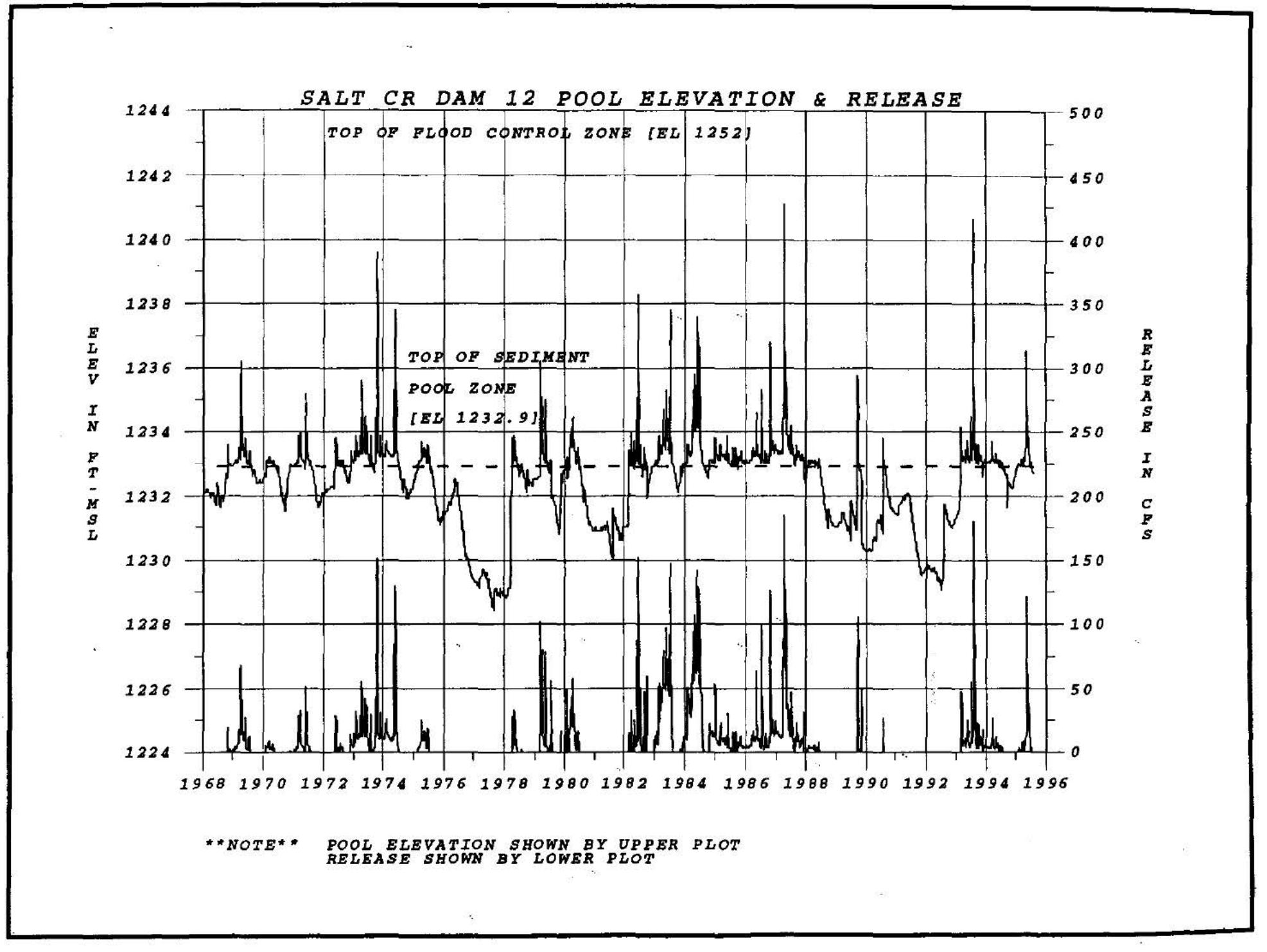
Peak Daily Inflow (CFS)
339, May 07

Peak Daily Outflow (CFS)
121, May 09

Peak Pool Elevation (Feet msl)
1236.55, May 08

Minimum Pool Elevation (Feet msl)
1231.36, Sep 17


SALT CR DAM 12 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1252]
TOP OF SEDIMENT POOL ZONE [EL 1232.9]
ELEV IN FT-MSL
RELEASE IN CFS
1238
1237
1236
1235
1234
1233
1232
1231
1230
1229
450
400
350
300
250
200
150
100
50
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 12 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1252]
TOP OF SEDIMENT
POOL ZONE
[EL 1232.9]
ELEV IN FT-MSL
RELEASE IN CFS
1244
1242
1240
1238
1236
1234
1232
1230
1228
1226
1224
500
450
400
350
300
250
200
150
100
50
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

TWIN LAKES DAM AND LAKE
SALT CREEK BASIN - NO. 13, NEBRASKA
1994-1995 REGULATION

The pool level started the report period below the flood control zone. It stayed below the flood control zone until the end of March. Then re-entered the flood control zone and remained until the middle of July. Runoff and precipitation were factors in the pool level entering flood control zone in March.

Heavy rainfall in April and May produced high pool levels. Inflows during those months were 81% and 379% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	632 cfs Jul 13 93	168 cfs Jun 30 83
2nd	539 cfs Mar 23 87	167 cfs Mar 24 87
3rd	507 cfs Jun 28 83	165 cfs Jul 27 93

	Pool-Date
Highest	1346.9 Jun 29 83
2nd	1346.0 Mar 23 87
3rd	1345.55 Jul 26 93

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1332.13 Oct 31 91
2nd	1332.2 Aug 18 89

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
4126, 98% of normal

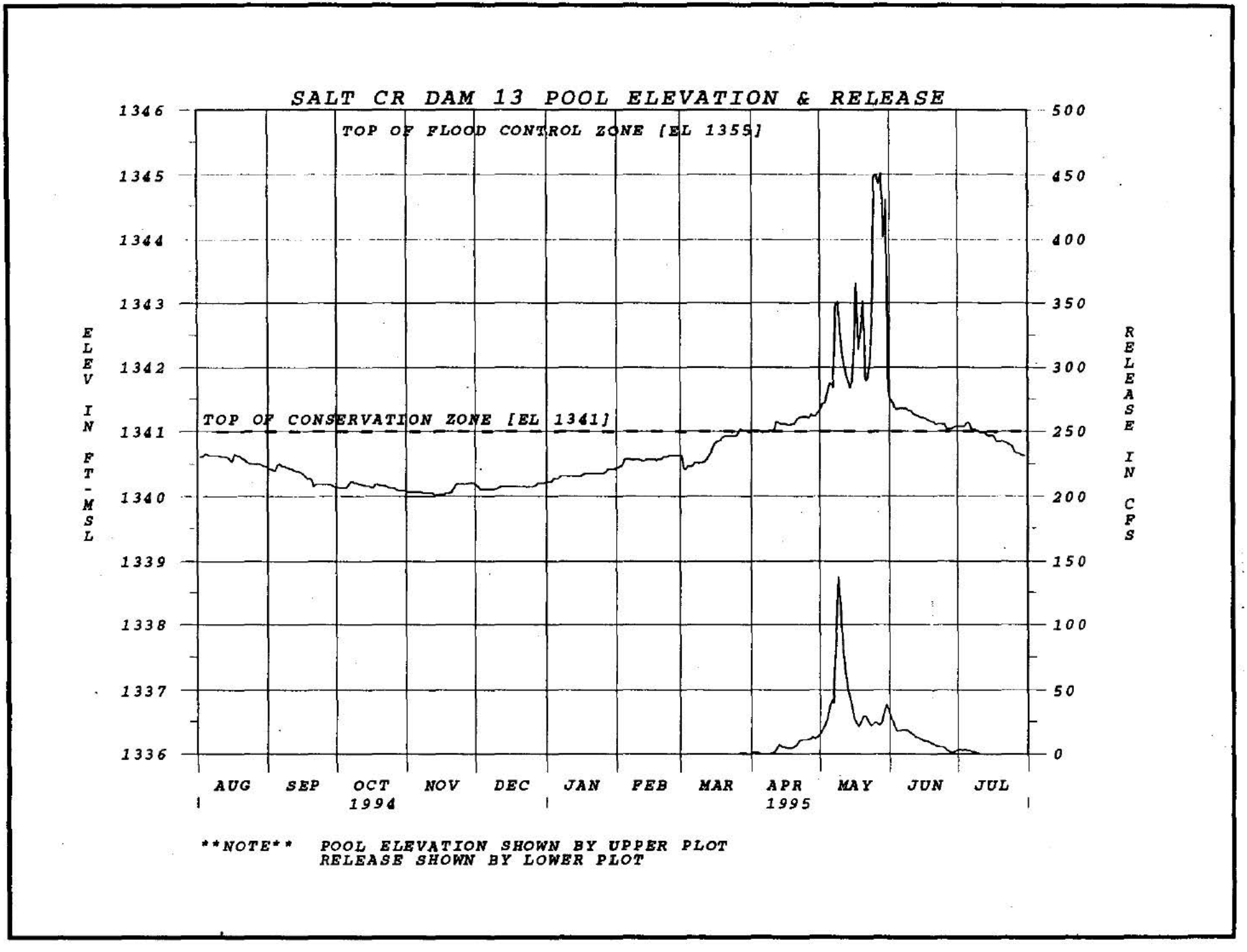
Total Outflow (AF)
3648, 110% of normal

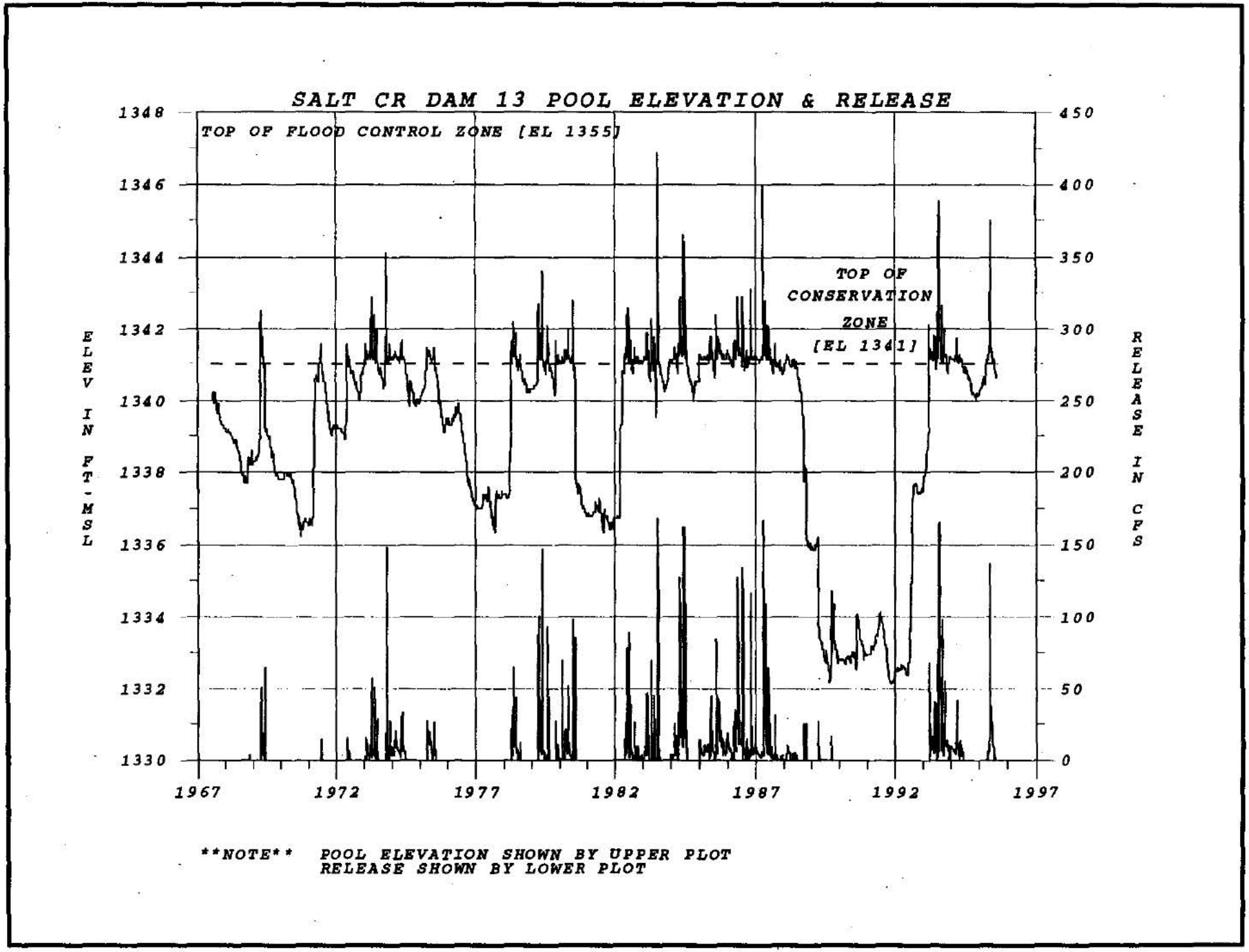
Peak Daily Inflow (CFS)
265, May 07

Peak Daily Outflow (CFS)
137, May 08

Peak Pool Elevation (Feet msl)
1343.02, May 08

Minimum Pool Elevation (Feet msl)
1340.02, Nov 12


SALT CR DAM 13 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1355]
TOP OF CONSERVATION ZONE [EL 1341]
ELEV IN FT-MSL
RELEASE IN CFS
1346
1345
1344
1343
1342
1341
1340
1339
1338
1337
1336
500
450
400
350
300
250
200
150
100
50
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 13 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1355]
TOP OF CONSERVATION ZONE [EL 1341]
ELEV IN FT-MSL
RELEASE IN CFS
1348
1346
1344
1342
1340
1338
1336
1334
1332
1330
450
400
350
300
250
200
150
100
50
0
1967
1972
1977
1982
1987
1992
1997
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

PAWNEE DAM AND LAKE
SALT CREEK BASIN - NO. 14, NEBRASKA
1994-1995 REGULATION

The pool level started the report period in the flood control zone and receded below this level during the middle of the month and remained until December. After re-entering the flood control in December, it remained throughout the period. Runoff and precipitation kept the pool level in the flood control zone. Heavy rainfall in April and May produced inflows of 77% and 314% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**	**Pool-Date**
Highest	1,381 cfs Mar 24 87	419 cfs Mar 25-26 87	1249.9 Jul 25 93
2nd	1,347 cfs Jul 13 93	420 cfs Jul 25 93	1248.4 Mar 24-25, 27 87
3rd	1,074 cfs Jul 19 85	311 cfs Jun 13 84	1247.1 Jun 12 84

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1240.2 Oct 14 79
2nd	1241.2 Jan 01 77

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
7675, 93% of normal

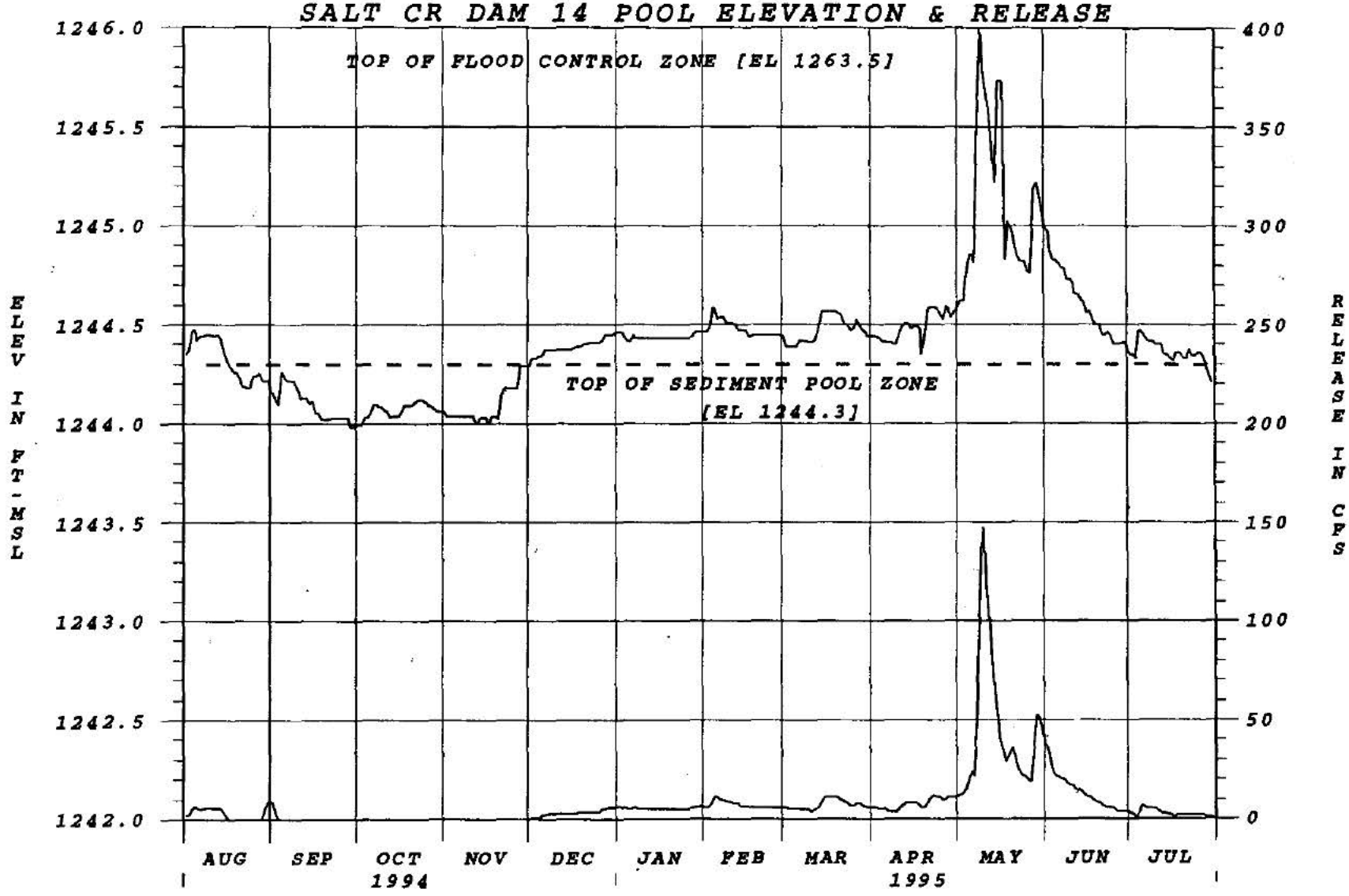
Total Outflow (AF)
5814, 105% of normal

Peak Daily Inflow (CFS)
353, May 07

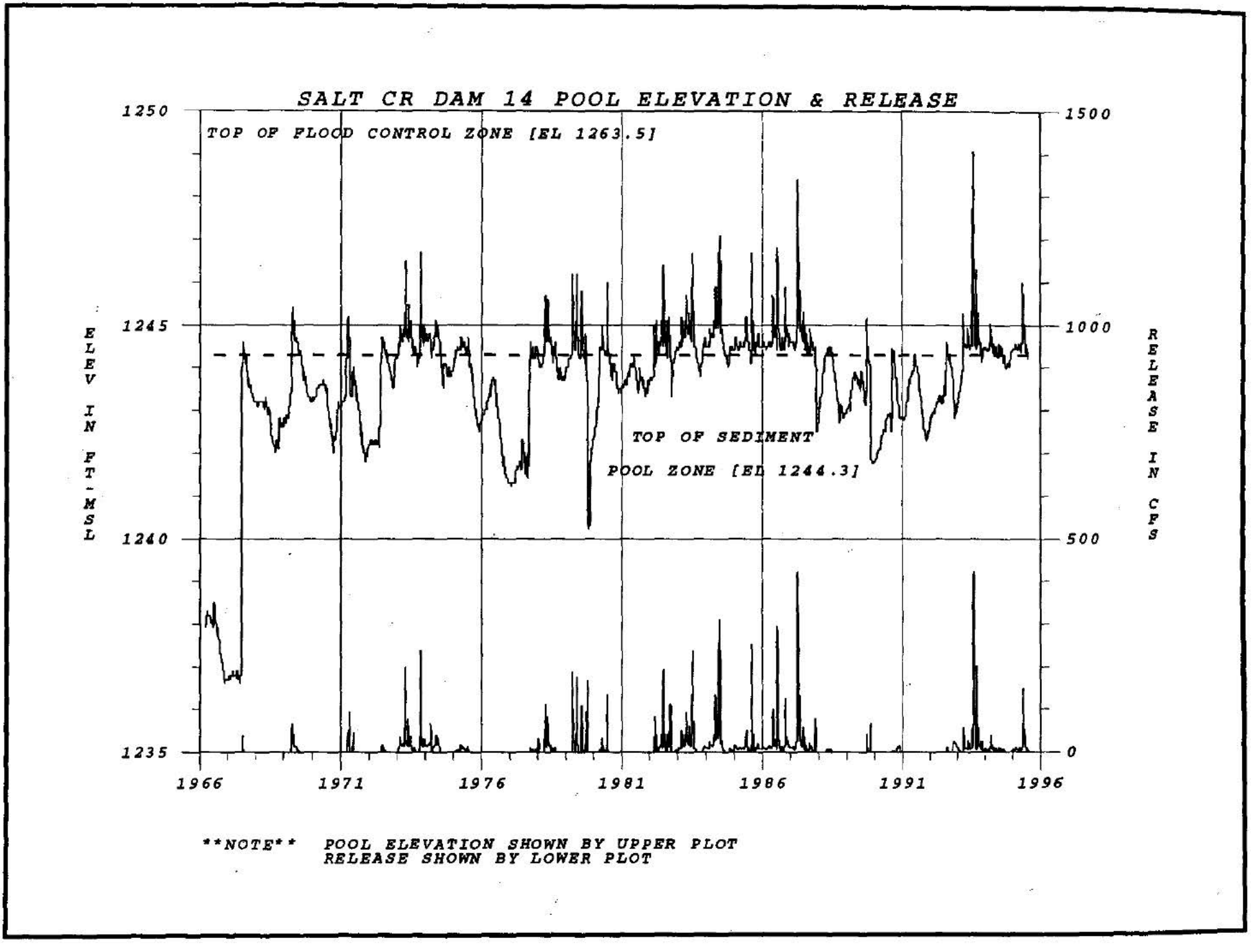
Peak Daily Outflow (CFS)
147, May 09

Peak Pool Elevation (Feet msl)
1245.99, May 08

Minimum Pool Elevation (Feet msl)
1243.98, Sep 28



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 14 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1263.5]
TOP OF SEDIMENT
POOL ZONE [EL 1244.3]
ELEV IN FT-MSL
RELEASE IN CFS
1250
1245
1240
1235
1500
1000
500
0
1966
1971
1976
1981
1986
1991
1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

ANTELOPE CREEK DAM AND HOLMES PARK LAKE
SALT CREEK BASIN - NO. 17, NEBRASKA
1994-1995 REGULATION

The pool level remained in the flood control zone during the beginning of the report period. The pool level receded below the flood control zone in November for a brief moment and re-entered it toward the end of November and remained throughout the report period.

Heavy rainfall during April and May produced significant rises in the pool level. Inflows to the project during those months were 238% and 628% of average respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	604 cfs Jul 24 93	187 cfs Jun 29 83
2nd	567 cfs Sep 08 89	174 cfs Jul 25 93
3rd	401 cfs Jun 27 83	140 cfs Sep 09 89

	Pool-Date
Highest	1249.97 Jul 24 93
2nd	1249.1 Sep 08 89
3rd	1248.1 Jun 27 83

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1232.9 Aug 03 77
2nd	1236.8 Feb 26 76

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
7323, 263% of normal

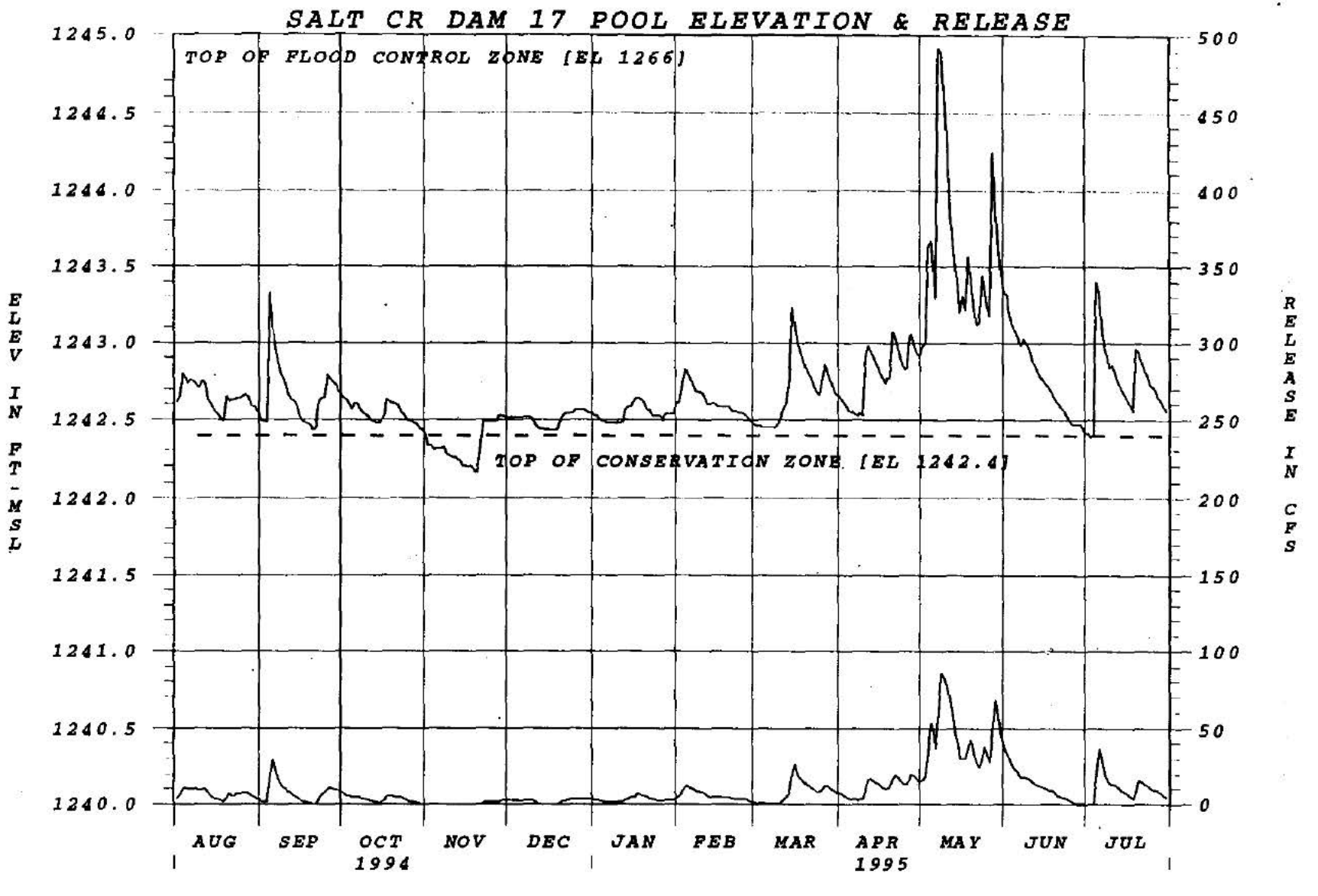
Total Outflow (AF)
7064, 314% of normal

Peak Daily Inflow (CFS)
176, May 07

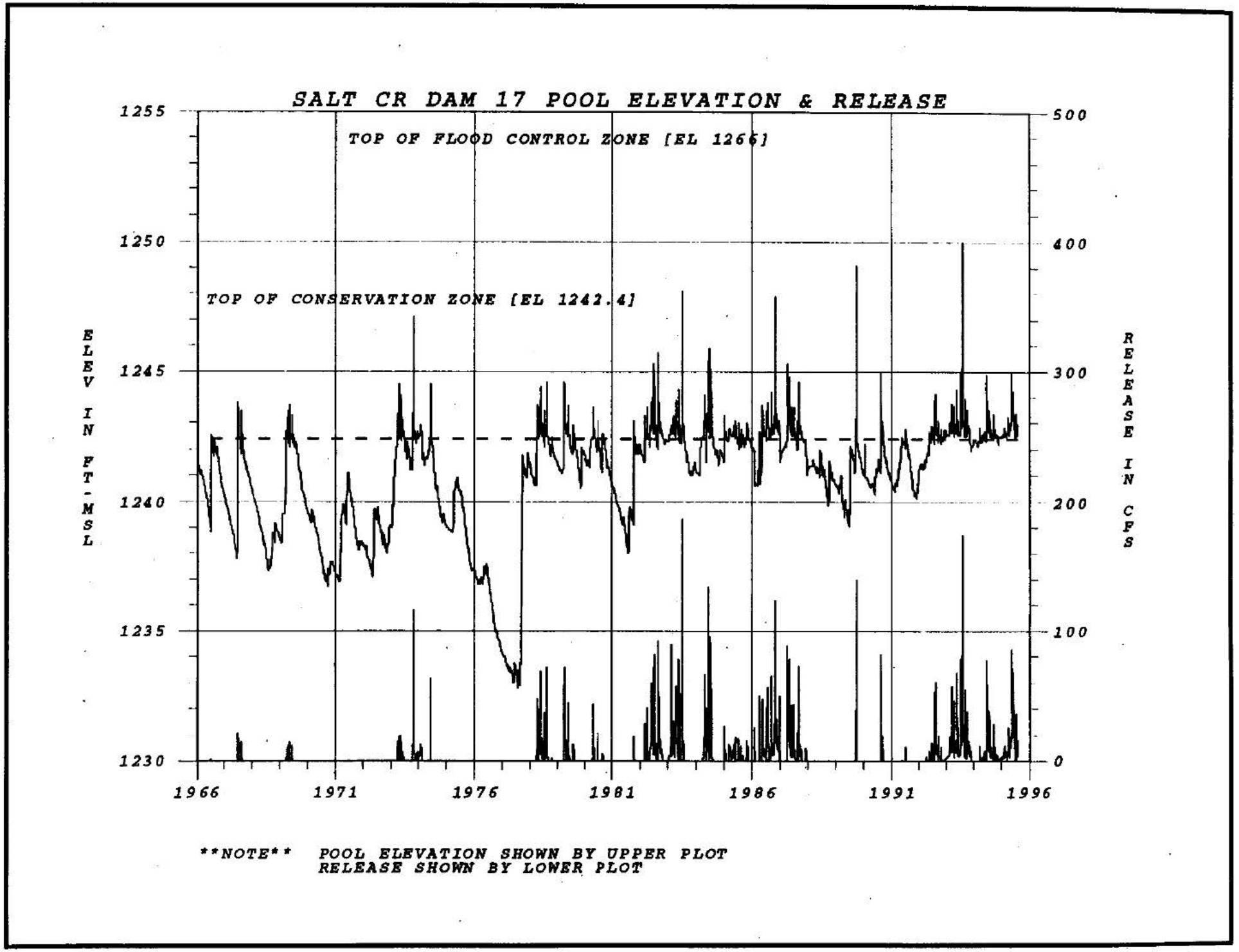
Peak Daily Outflow (CFS)
86, May 08

Peak Pool Elevation (Feet msl)
1244.92, May 07

Minimum Pool Elevation (Feet msl)
1242.16, Nov 19



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


SALT CR DAM 17 POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1266]
TOP OF CONSERVATION ZONE [EL 1242.4]
ELEV IN FT-MSL
RELEASE IN CFS
1255
1250
1245
1240
1235
1230
500
400
300
200
100
0
1966
1971
1976
1981
1986
1991
1996
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

BRANCHED OAK DAM AND LAKE
SALT CREEK BASIN - NO. 18, NEBRASKA
1994-1995 REGULATION

The pool level stayed in the flood control zone throughout the report period. Rainfall and runoff were the major factors in the pool level remaining in the flood control zone.

Rainfall of (3.36 and 6.68 inches) at the damsite caused high rises in the pool level. Inflows during April and May produce inflows of 177% and 291% respectively.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	3,700 cfs Aug 25 87	774 cfs Jul 25 93
2nd	2,435 cfs Mar 23 87	730 cfs Aug 26 87
3rd	1,820 cfs Jul 23 93	670 cfs Jun 19 83

	Pool-Date
Highest	1287.9 Aug 26 87
2nd	1287.79 Jul 24 93
3rd	1287.7 Jun 18 83
	Mar 23 87

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1280.9 Jan 01 77
2nd	1281.5 Nov 25 89

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
45,216, 150% of normal

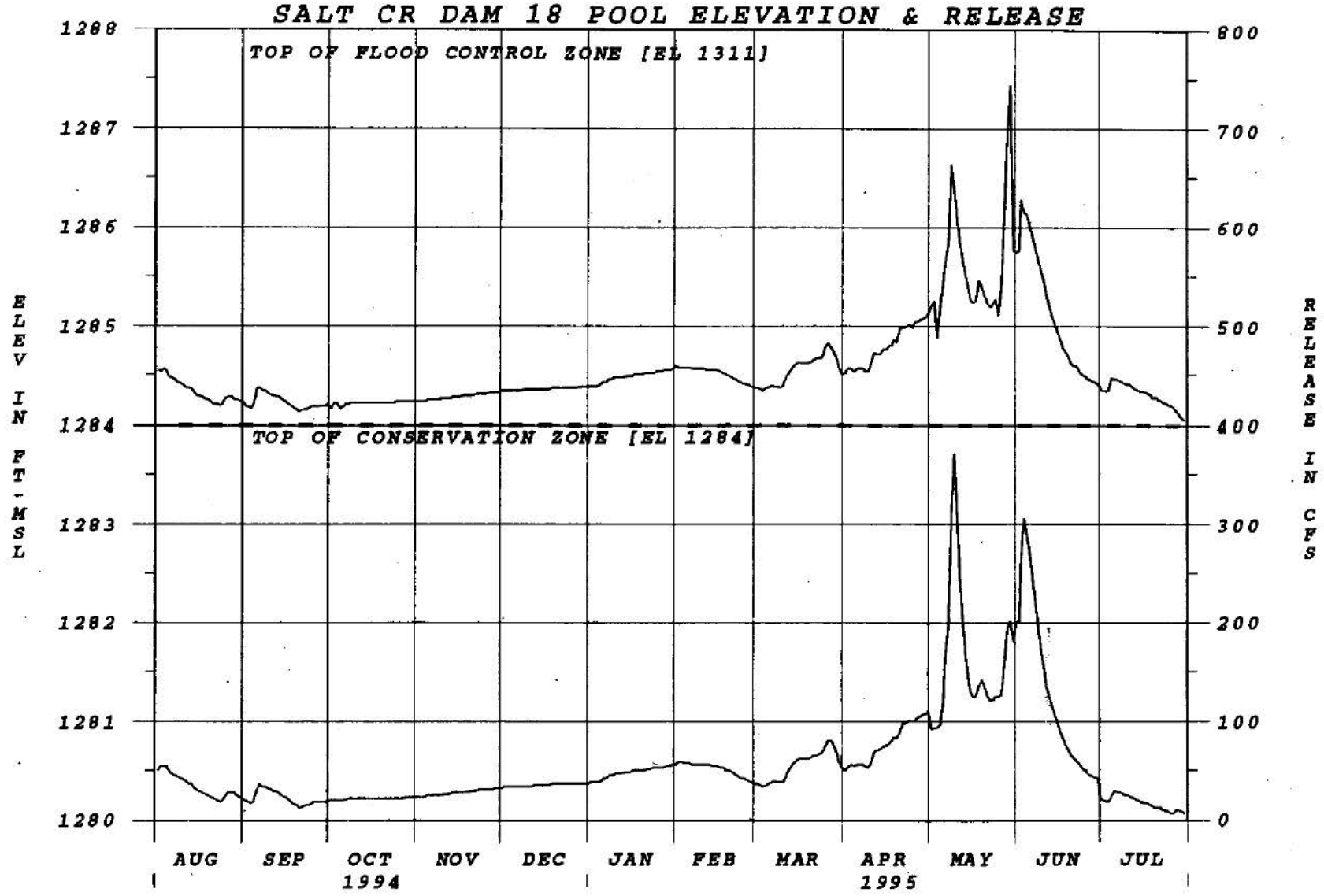
Total Outflow (AF)
41,295, 175% of normal

Peak Daily Inflow (CFS)
1096, May 08

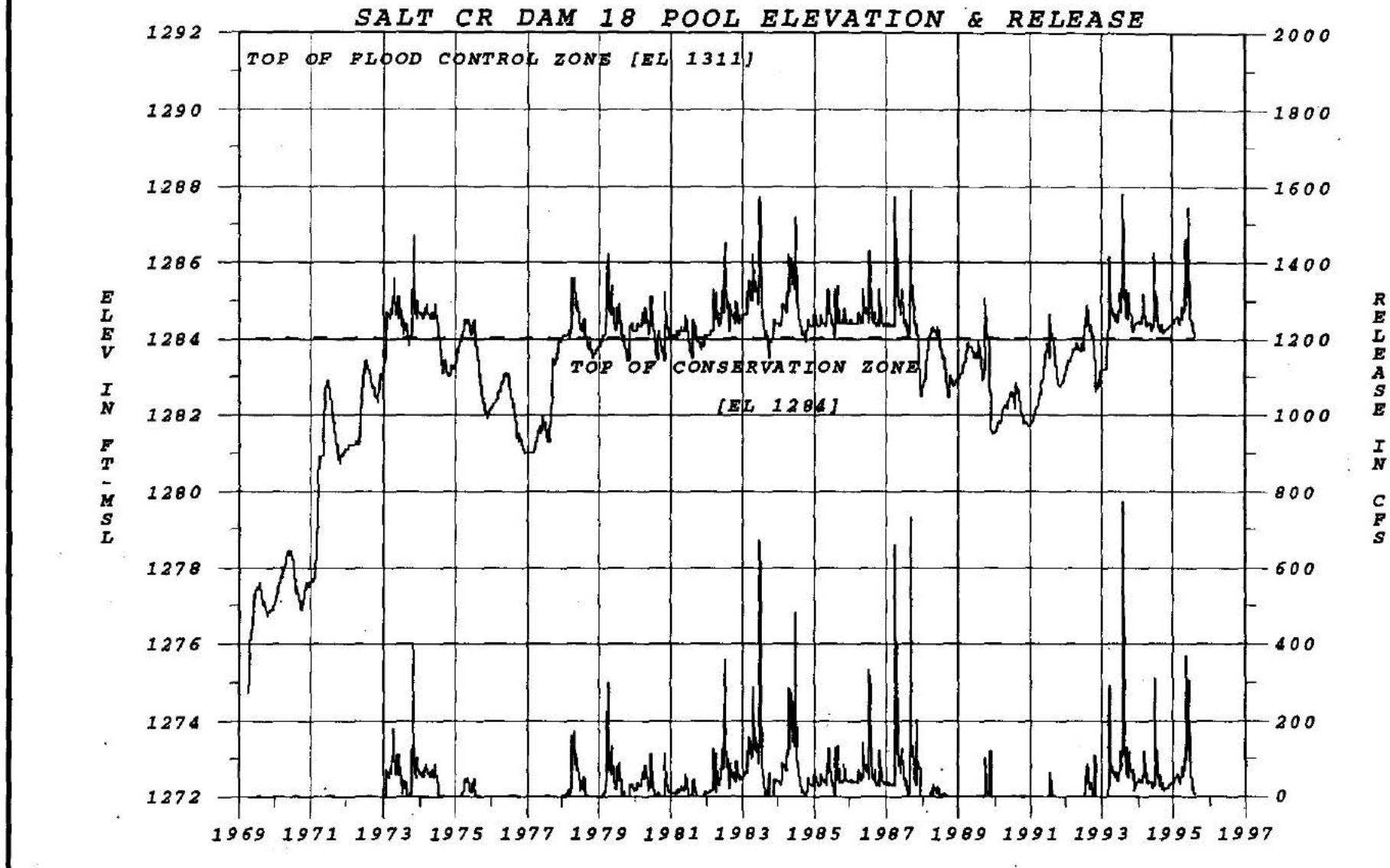
Peak Daily Outflow (CFS)
371, May 09

Peak Pool Elevation (Feet msl)
1286.64, May 08

Minimum Pool Elevation (Feet msl)
1284.13, Sep 20



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

SNAKE CREEK DAM AND LAKE AUDUBON
LAKE SAKAKAWEA SUBIMPOUNDMENT
MISSOURI RIVER BASIN, NORTH DAKOTA
1994-1995 REGULATION

Lake Audubon, a subimpoundment of Garrison Reservoir, is located 8 miles northeast of Riverdale, North Dakota. The embankment, known as "Snake Creek", has a crest elevation of 1865.0 feet msl. The original planned operating level of 1850.0 feet msl, Lake Audubon would cover 20,600 acres and contains 396,000 acre-feet of water. The latest agreed on operating level of 1847.5 feet msl would cover 19,095 acres and contains 346,419 AF of water.

The embankment was constructed with the primary purpose of relocating U.S. Highway 83 and the Soo Line Railroad across the Snake Creek Arm of the Garrison Diversion. In addition, during the planning stage it was decided to create a gated subimpoundment for the dual purpose of fish and wildlife enhancement, and the future diversion of water for anticipated irrigation. The pool level has been kept below elevation 1850.0 feet msl because (1) all land surrounding the lake has not been acquired to maintain the 1850.0 feet msl level and (2) that level (head) is not needed to supply water to the revised lower irrigation acreage. Garrison pool levels are limited to less than 15 feet above the Audubon pool for dam safety consideration. Most of the time, however, the Lake Audubon level is higher than the Garrison pool. If the latter condition exists, the Snake Creek pumping plant, operated by the Bureau, if used to transfer water from the Garrison Reservoir to Lake Audubon. Gravity flow discharge to or from Lake Audubon is conveyed by a gated conduit 7 feet wide by 10 feet high with invert elevation at 1810.0 feet msl. This gated conduit is normally closed.

Lake Audubon was operated in accordance with the 1987 Letter of Understanding between the Corps, the Bureau of Reclamation, Fish and Wildlife Service, and the North Dakota Game and Fish Department.

Maximums of Record:

	Pool Date
Highest	1848.61 Apr 26 76
2nd	1848.57 May 21 79
3rd	1847.38 Jun 29 93

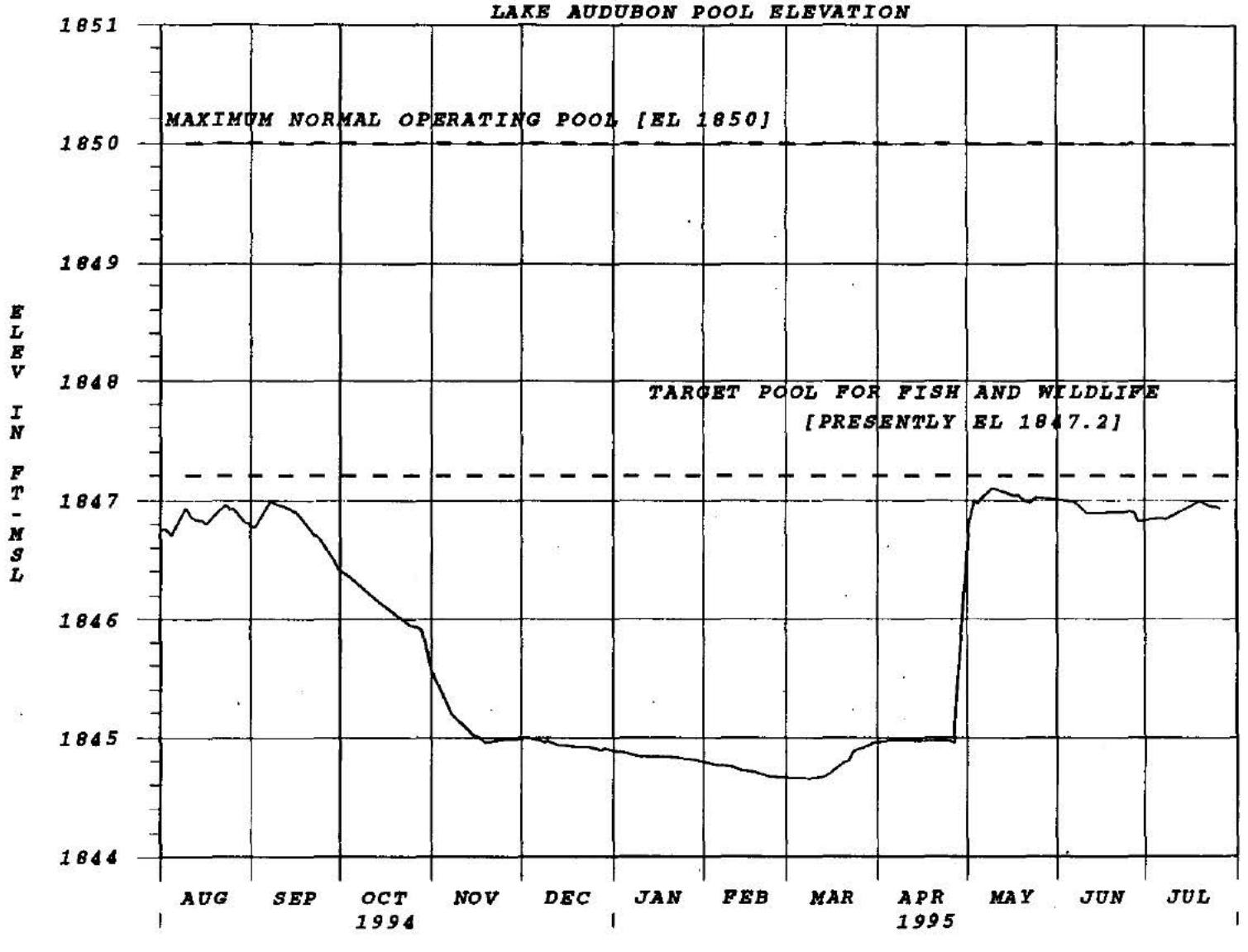
Minimums of Records:

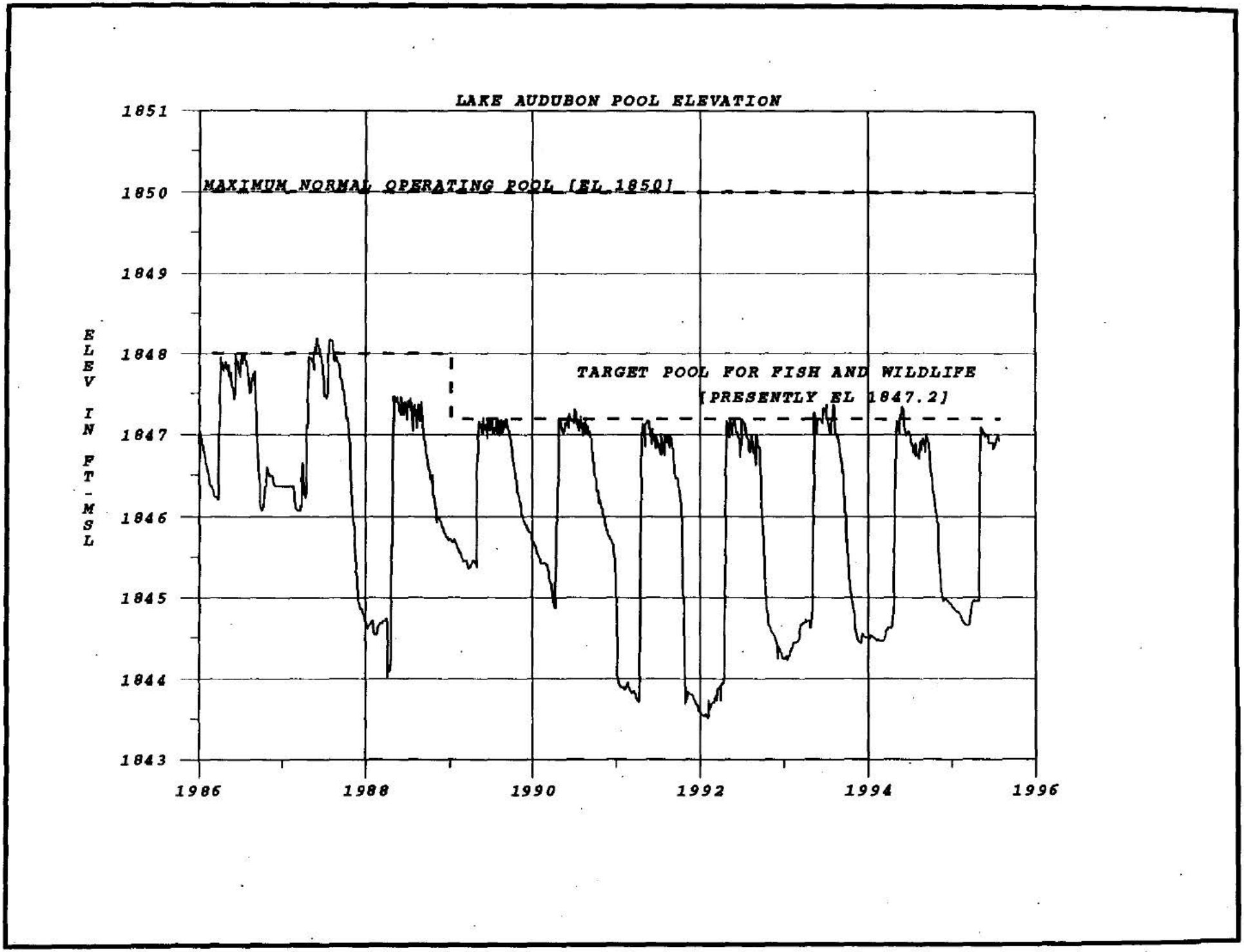
	Pool Date
Lowest	1843.39 Mar 13 85
2nd	1843.50 Jan 27 92

Report Period: (August 1, 1994 through July 31, 1995)

Peak Pool Elevation (Feet msl)
1847.09, May 09

Minimum Pool Elevation (Feet msl)
1844.65, Mar 07


LAKE AUDUBON POOL ELEVATION
1851
1850
1849
1848
1847
1846
1845
1844
ELEV IN FT-MSL
MAXIMUM NORMAL OPERATING POOL [EL 1850]
TARGET POOL FOR FISH AND WILDLIFE
[PRESENTLY EL 1847.2]
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL


LAKE AUDUBON POOL ELEVATION
MAXIMUM NORMAL OPERATING POOL [EL 1850]
TARGET POOL FOR FISH AND WILDLIFE
[PRESENTLY EL 1847.2]
ELEV IN FT-MSL
1851
1850
1849
1848
1847
1846
1845
1844
1843
1986
1988
1990
1992
1994
1996

SPRING CREEK DAM AND LAKE POCASSE
(LAKE OAHE SUBIMPOUNDMENT)
MISSOURI RIVER BASIN, SOUTH DAKOTA
1994-1995 REGULATION

Lake Pocasse is operated and administered as the Pocasse National Wildlife Refuge by the Department of the Interior's Fish and Wildlife Service under an agreement with the Corps of Engineers. The pool levels of Oahe Reservoir and Lake Pocasse are contiguous at or above elevation 1617.0 feet msl, the top of the annual flood control and multiple use zone in Lake Oahe. The long-term plan of regulation is to maintain the Lake Pocasse level as high as possible. Every 4 to 5 years, an early summer drawdown to elevation 1614.0 feet msl will assist in the re-establishment of shoreline vegetation and improved water quality. In addition, upon evaluation of hydrologic conditions prior to the spring runoff each year above Pocasse, decisions may be made by the Section to lower the pool to accommodate the appropriate runoff volumes.

Maximums of Record:

	Pool-Date
Highest	1625.00 Mar 23 87
2nd	1622.98 Mar 18 95
3rd	1621.96 Jul 29 93

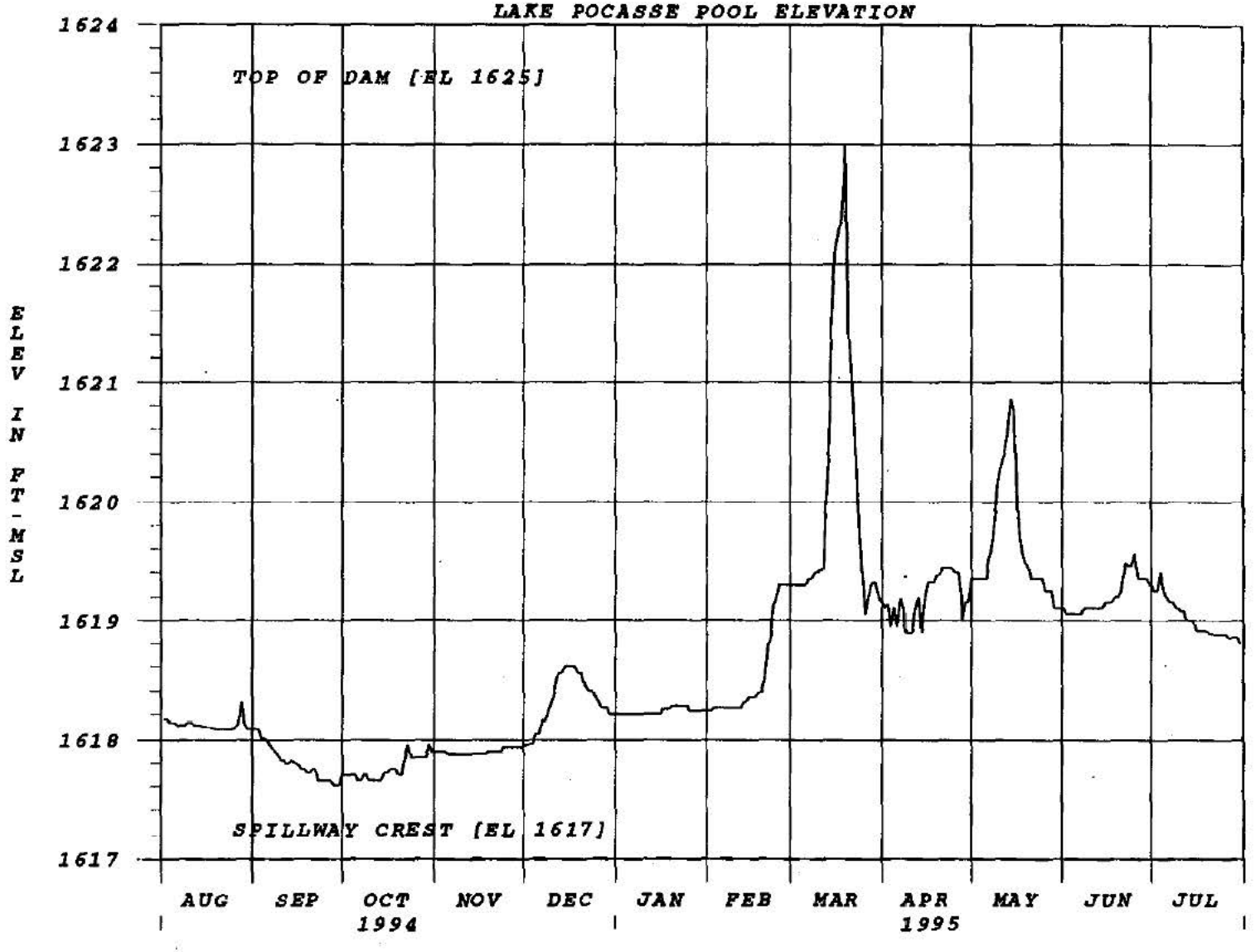
Minimums of Record (since initial fill):

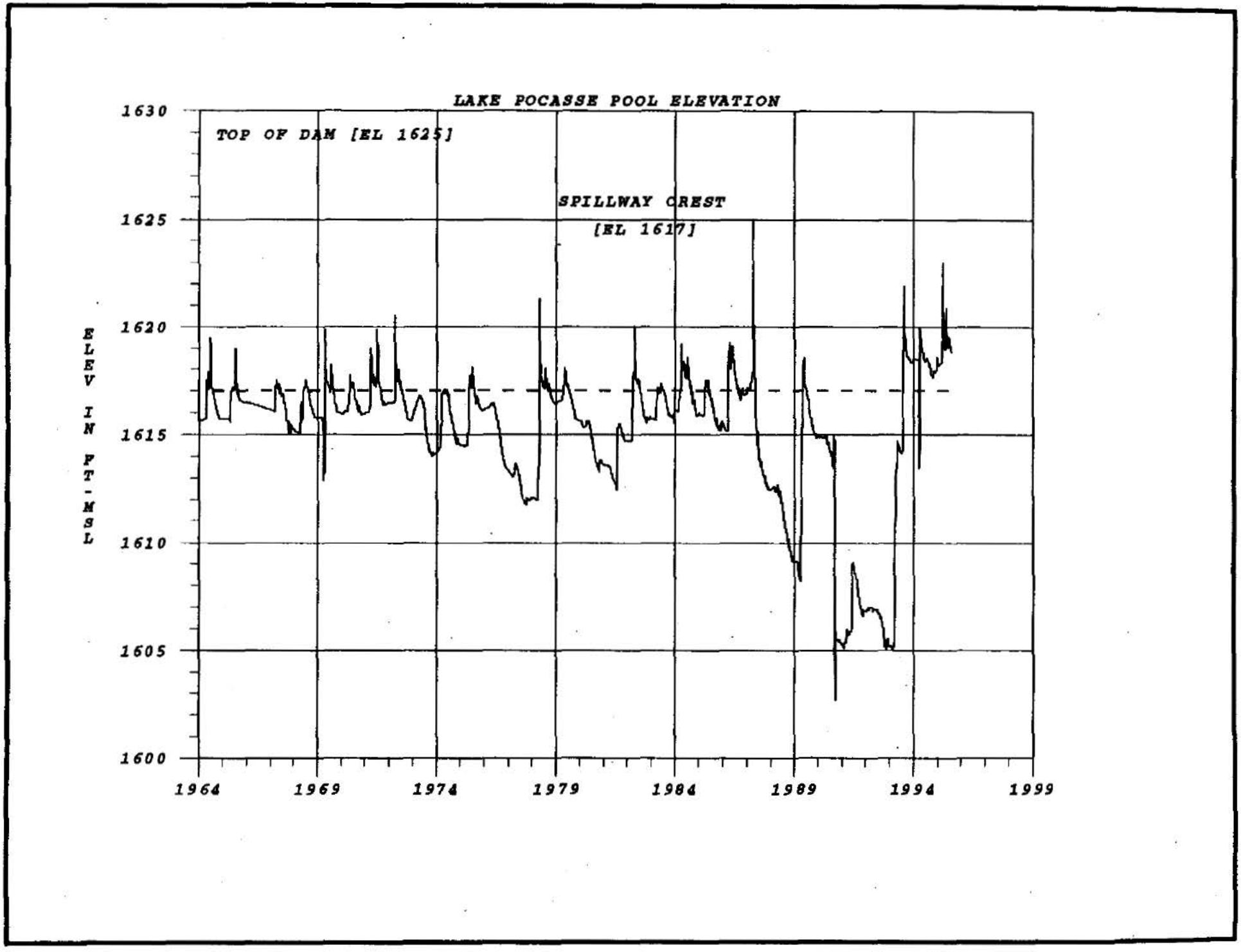
	Pool-Date
Lowest	1602.69 Sep 22 90
2nd	1605.02 Oct 24 92
3rd	1606.55 Oct 29 91

Report Period: (August 1, 1994 through July 31, 1995)

Peak Pool Elevation (Feet msl)
1622.98, Mar 18

Minimum Pool Elevation (Feet msl)
1617.62, Sep 28


LAKE POCASSE POOL ELEVATION
TOP OF DAM [EL 1625]
SPILLWAY CREST [EL 1617]
ELEV IN FT-MSL
1624
1623
1622
1621
1620
1619
1618
1617
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL


LAKE POCASSE POOL ELEVATION
TOP OF DAM [EL 1625]
SPILLWAY CREST
[EL 1617]
ELEV IN FT-MSL
1630
1625
1620
1615
1610
1605
1600
1964
1969
1974
1979
1984
1989
1994
1999

RECLAMATION PROJECTS

Regulated for flood control according to regulations in the Federal Register and supplemental agreements (between the Bureau of Reclamation and Corps of Engineers) in compliance with the 1944 Flood Control Act.

BOYSEN DAM	1.78
CANYON FERRY DAM	1.81
CLARK CANYON DAM	1.84
GLENDO DAM	1.87
HEART BUTTE DAM	1.90
JAMESTOWN DAM	1.93
KEYHOLE DAM	1.96
PACTOLA DAM	1.99
SHADEHILL DAM	1.102
TIBER DAM	1.105
YELLOWTAIL DAM	1.109

BOYSEN DAM AND LAKE
BIGHORN RIVER BASIN, WYOMING
1994-1995 REGULATION

Boysen Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated May 5, 1967. When this occurs release determination is the responsibility of the Corps of Engineers (District Engineer). Refer to Chapter VI for the writeup of the flood control regulation for Boysen Reservoir.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	19,253 cfs Jun 23 67	14,204 cfs Jul 07 67
2nd	17,975 cfs Jun 17 63	10,688 cfs Jun 16 91
3rd	16,516 cfs Jun 15 91	9,512 cfs Jul 16 95

	Pool-Date
Highest	4730.83 Jul 06 67
2nd	4729.85 Jul 05 57
3rd	4729.18 Jun 16 91

Minimums of Record (since initial fill):

	Pool-Date
Lowest	4684.18 Mar 18-19 56
2nd	4686.42 Sep 21 60

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
1,438,979, 142% of normal

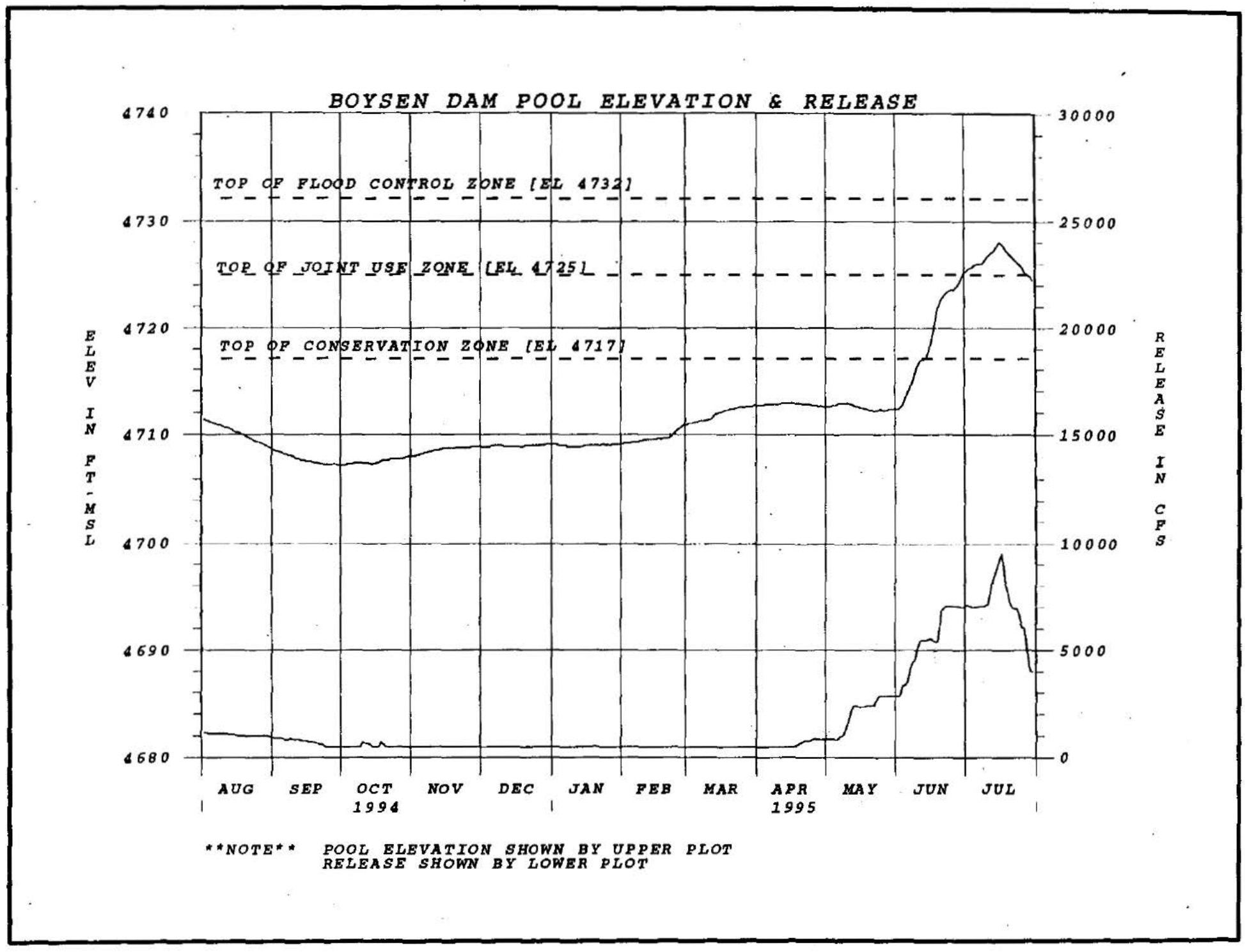
Total Outflow (AF)
1,214,987, 121% of normal

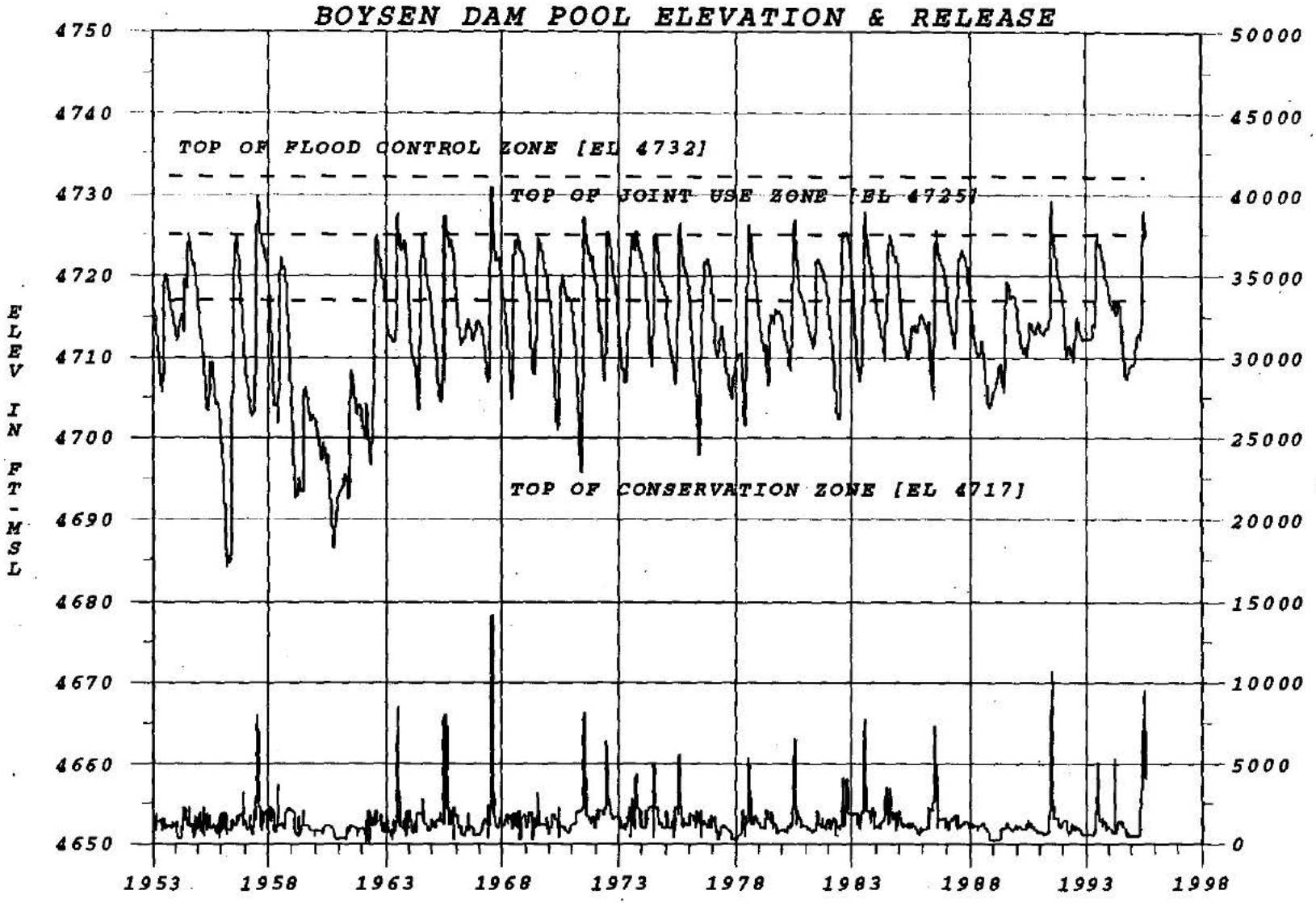
Peak Daily Inflow (CFS)
15,899, Jun 17

Peak Daily Outflow (CFS)
9512, Jul 16

Peak Pool Elevation (Feet msl)
4727.99, Jul 15

Minimum Pool Elevation (Feet msl)
4707.19, Oct 02


BOYSEN DAM POOL ELEVATION & RELEASE
4740
4730
4720
4710
4700
4690
4680
ELEV IN FT-MSL
30000
25000
20000
15000
10000
5000
0
RELEASE IN CFS
TOP OF FLOOD CONTROL ZONE [EL 4732]
TOP OF JOINT USE ZONE [EL 4725]
TOP OF CONSERVATION ZONE [EL 4717]
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

CANYON FERRY DAM AND RESERVOIR
MISSOURI RIVER BASIN, MONTANA
1994-1995 REGULATION

Canyon Ferry Reservoir is regulated by the Bureau (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control, as per the Field Working Agreement dated May 23, 1977. When this occurs, release determination is the responsibility of the Corps (District Engineer).

The pool entered the exclusive flood zone on July 1 and dropped below the flood control zone on July 29. The peak inflow of 26,671 on June 9 was reduced to a discharge of 13,750 cfs..

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	29,050 cfs May 24 81	25,720 cfs Jun 13 81
2nd	27,570 cfs Jun 19 74	24,370 cfs Jun 19 64
3rd	27,110 cfs May 30 56	24,030 cfs May 31 56

	Pool-Date
Highest	3800.00 55, 56, 62
2nd	3799.93 Jul 07-12 75
3rd	3799.66 Jun 04-5 62

Minimums of Record (since initial fill):

	Pool-Date
Lowest	3764.70 Apr 11 67
2nd	3772.75 Mar 25 62

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
5,174,160, 129% of normal

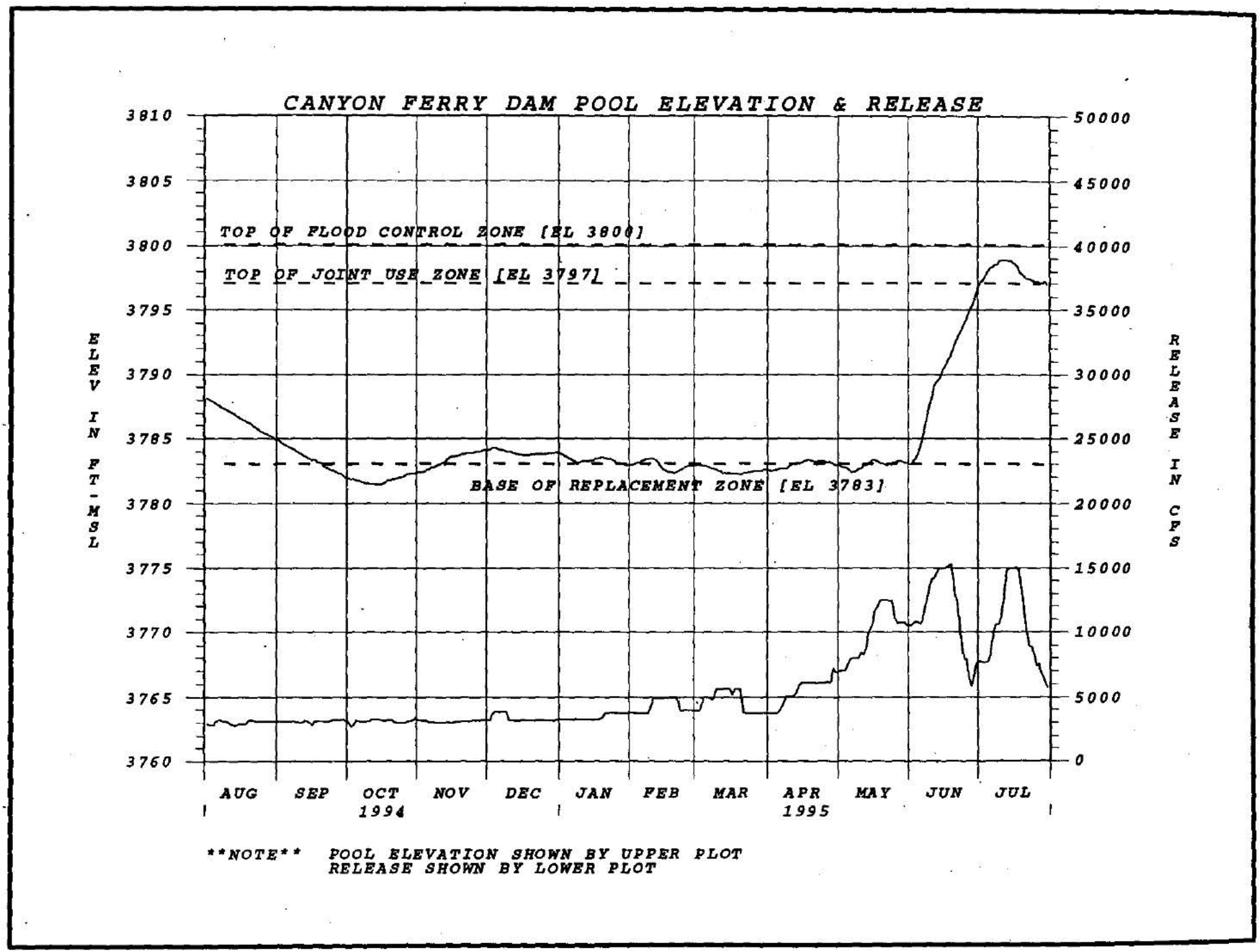
Total Outflow (AF)
4,185,232, 114% of normal

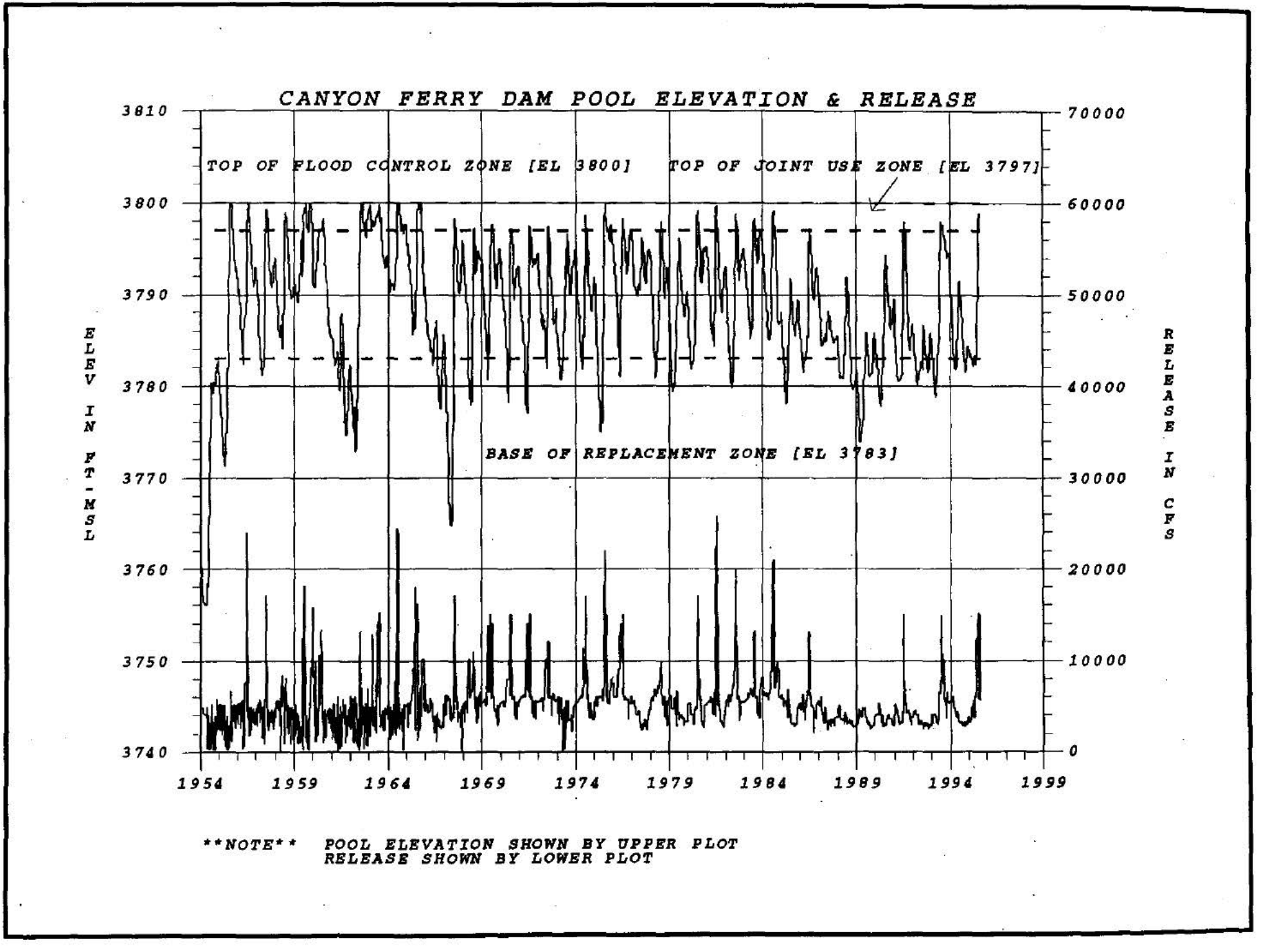
Peak Daily Inflow (CFS)
26671, Jun 09

Peak Daily Outflow (CFS)
15,160, Jun 18

Peak Pool Elevation (Feet msl)
3798.85, Jul 10

Minimum Pool Elevation (Feet msl)
3782.18, Mar 19


CANYON FERRY DAM POOL ELEVATION & RELEASE
3810
3805
3800
3795
3790
3785
3780
3775
3770
3765
3760
ELEV IN FT-MSL
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
RELEASE IN CFS
TOP OF FLOOD CONTROL ZONE [EL 3800]
TOP OF JOINT USE ZONE [EL 3797]
BASE OF REPLACEMENT ZONE [EL 3783]
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


CANYON FERRY DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 3800]
TOP OF JOINT USE ZONE [EL 3797]
BASE OF REPLACEMENT ZONE [EL 3783]
ELEV IN FT-MSL
RELEASE IN CFS
3810
3800
3790
3780
3770
3760
3750
3740
70000
60000
50000
40000
30000
20000
10000
0
1954
1959
1964
1969
1974
1979
1984
1989
1994
1999
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

CLARK CANYON DAM AND RESERVOIR
BEAVERHEAD RIVER BASIN, MONTANA
1994-1995 REGULATION

Clark Canyon Reservoir (Hap Hawkins Lake) is regulated by the Bureau (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control, as per the Field Working Agreement dated November 19, 1971. When this occurs, release determination is the responsibility of the Corps (District Engineer).

Clark Canyon briefly entered the flood control zone from June 6 to August 22, 1995. Releases were held to a maximum of 1,538 cfs. Channel capacity is 1500 cfs.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	3,416 cfs Jun 22 84	2,561 cfs Jun 25 84
2nd	2,800 cfs Jun 20 75	1,538 cfs Jul 26 95
3rd	2,563 cfs Jun 06 95	1,289 cfs Jul 31 75

	Pool-Date
Highest	5564.70 Jun 25 84
2nd	5556.88 Jul 22 75
3rd	5554.54 Jun 25 76

Minimums of Record (since initial fill):

	Pool-Date
Lowest	5508.67 Aug 23-25 89
2nd	5509.83 Sep 24 92

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
332,397, 117% of normal

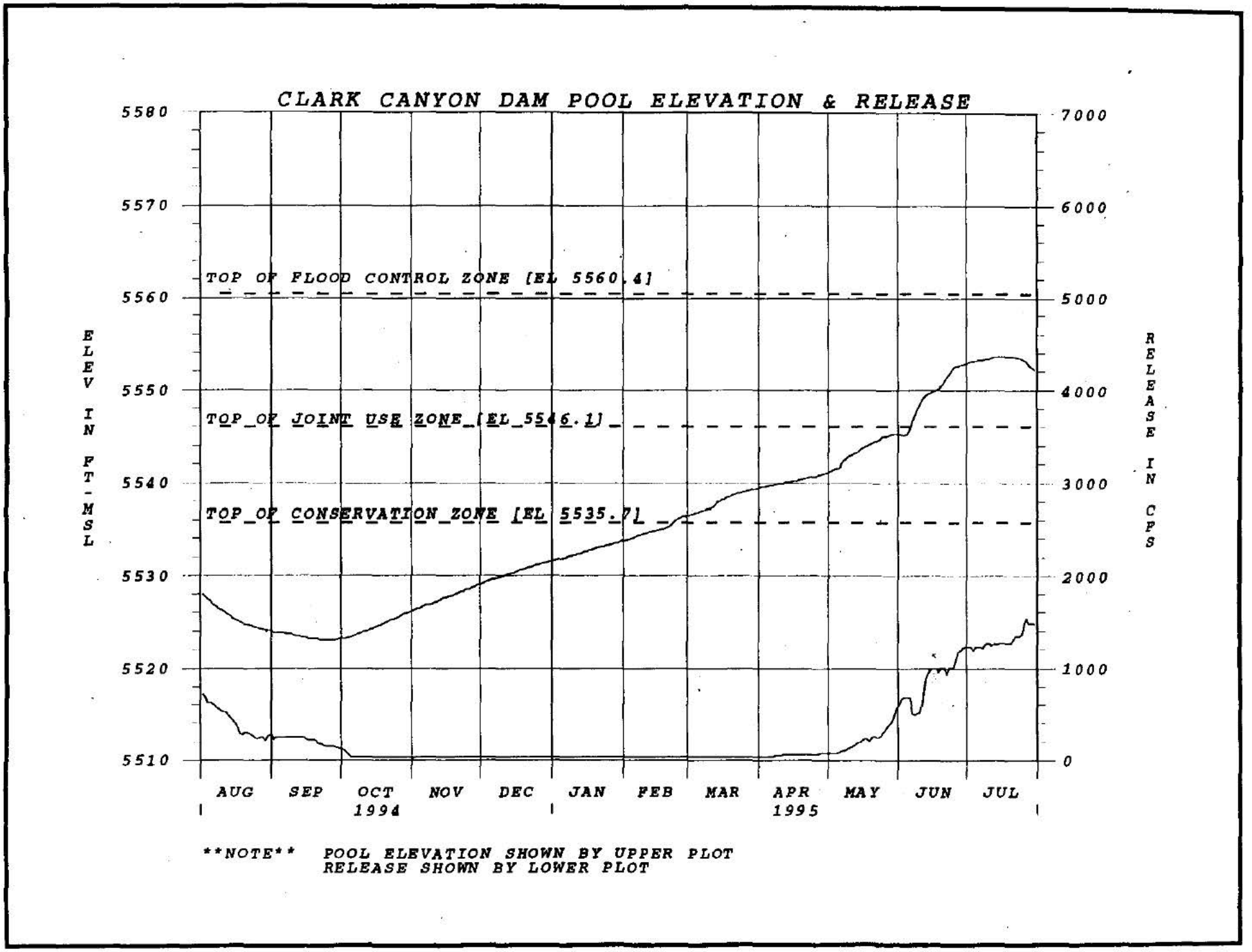
Total Outflow (AF)
205,217, 76% of normal

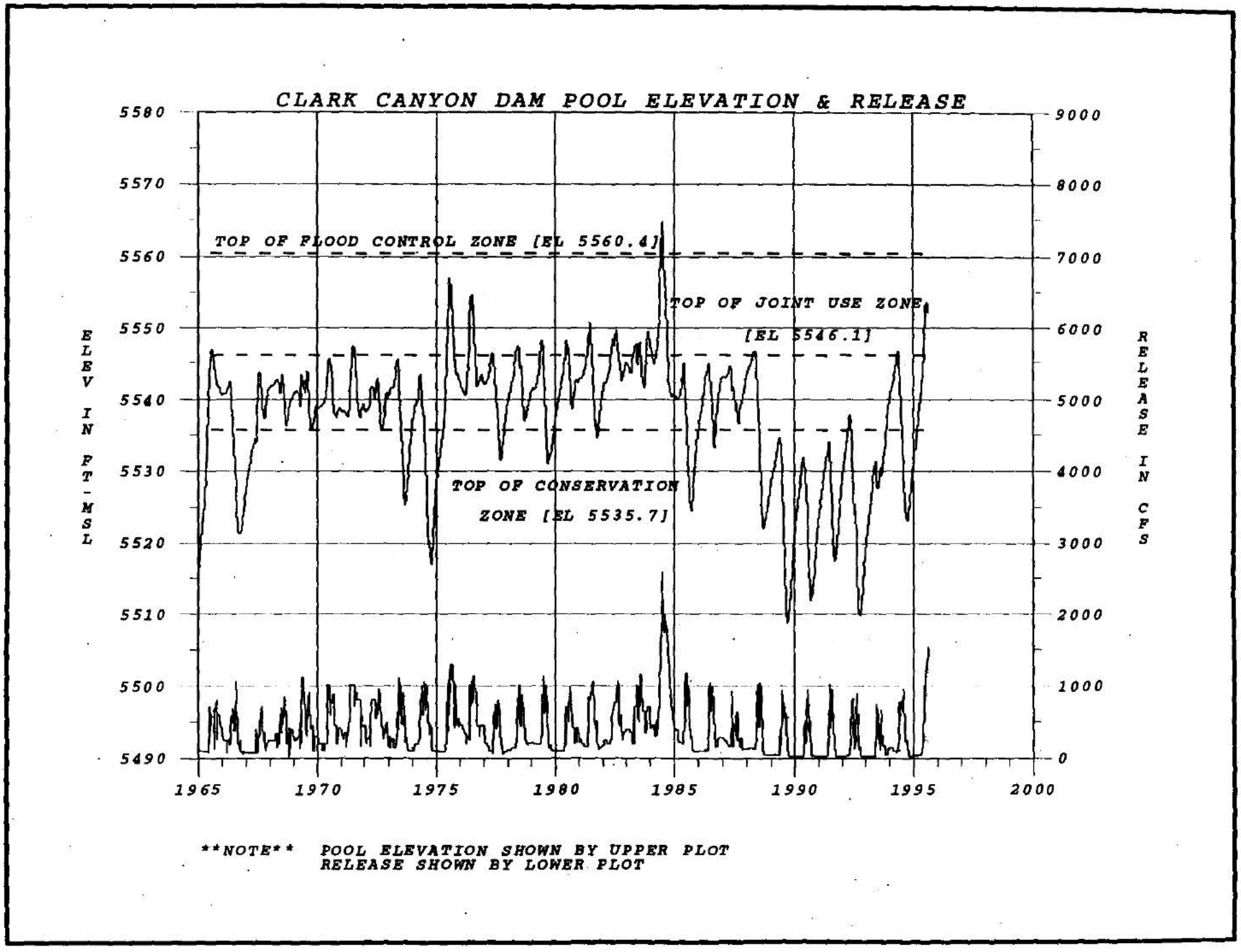
Peak Daily Inflow (CFS)
2563, Jun 06

Peak Daily Outflow (CFS)
1538, Jul 26

Peak Pool Elevation (Feet msl)
5553.68, Jul 15

Minimum Pool Elevation (Feet msl)
5523.11, Sep 26


CLARK CANYON DAM POOL ELEVATION & RELEASE
5580
5570
5560
5550
5540
5530
5520
5510
7000
6000
5000
4000
3000
2000
1000
0
TOP OF FLOOD CONTROL ZONE [EL 5560.4]
TOP OF JOINT USE ZONE [EL 5546.1]
TOP OF CONSERVATION ZONE [EL 5535.7]
ELEV IN FT-MSL
RELEASE IN CFS
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT


CLARK CANYON DAM POOL ELEVATION & RELEASE
ELEV IN FT-MSL
RELEASE IN CFS
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1965
1970
1975
1980
1985
1990
1995
2000
TOP OF FLOOD CONTROL ZONE [EL 5560.4]
TOP OF JOINT USE ZONE
[EL 5546.1]
TOP OF CONSERVATION
ZONE [EL 5535.7]
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

GLENDO DAM AND RESERVOIR
NORTH PLATTE RIVER BASIN, WYOMING
1994-1995 REGULATION

Glendo Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone. When this occurs, release determination is the responsibility of the Corps (District Engineer) as per the Field Working Agreement dated May 12, 1977. Refer to Chapter VI for the writeup of the flood control regulation for Glendo Dam.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	18,840 cfs May 15 65	10,292 cfs Jun 30 84
2nd	17,560 cfs Jun 13 70	10, 266 cfs Jul 01 84
3rd	14,661 cfs May 21 73	10,060 cfs Aug 26 83

	Pool-Date
Highest	4650.90 May 27 73
2nd	4650.27 Jun 14 83
3rd	4648.45 May 31 71

Minimums of Record (since initial fill):

	Pool-Date
Lowest	4548.10 Sep 28 66
2nd	4560.42 Sep 26 72

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
1,137,790, 98% of normal

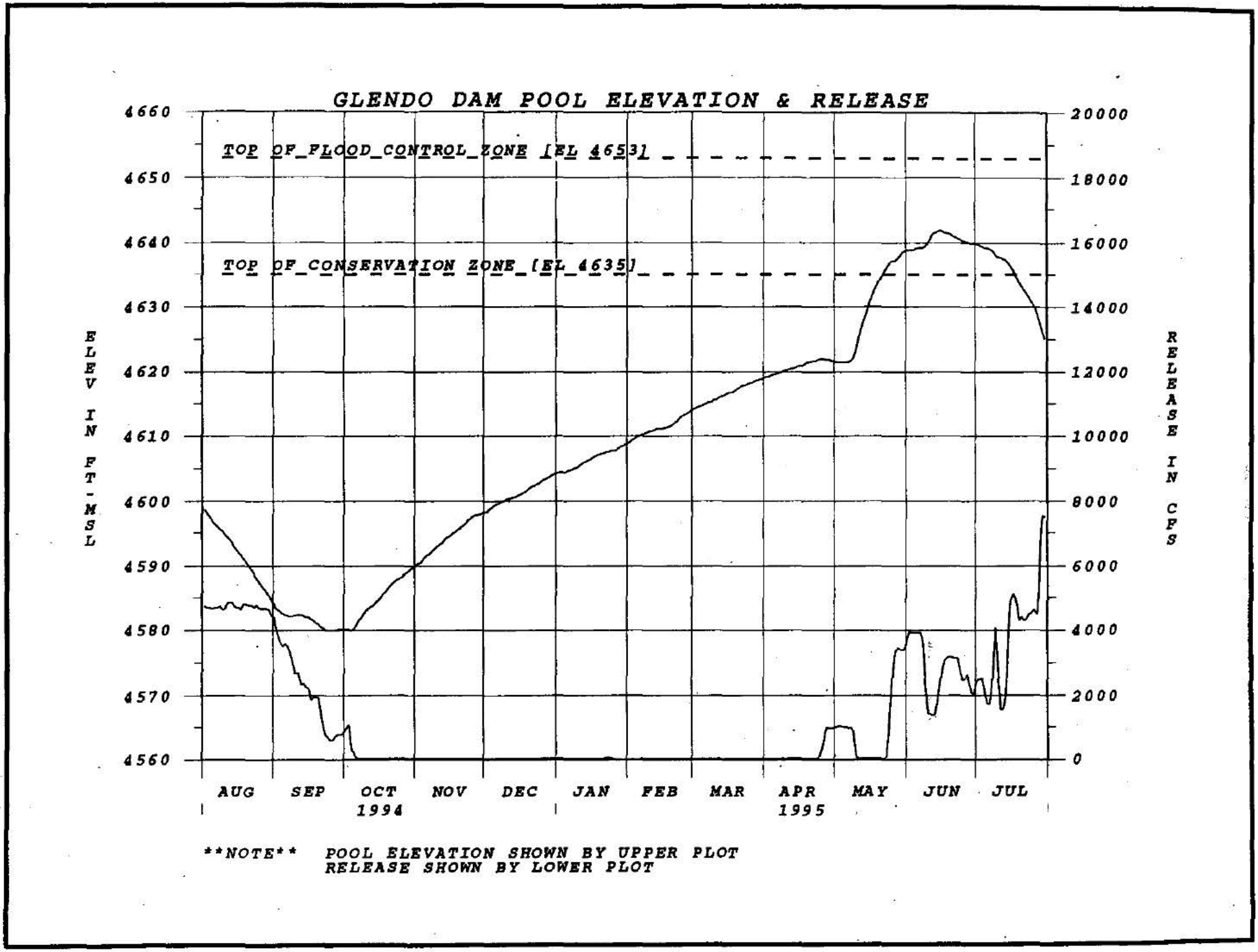
Total Outflow (AF)
917,403, 81% of normal

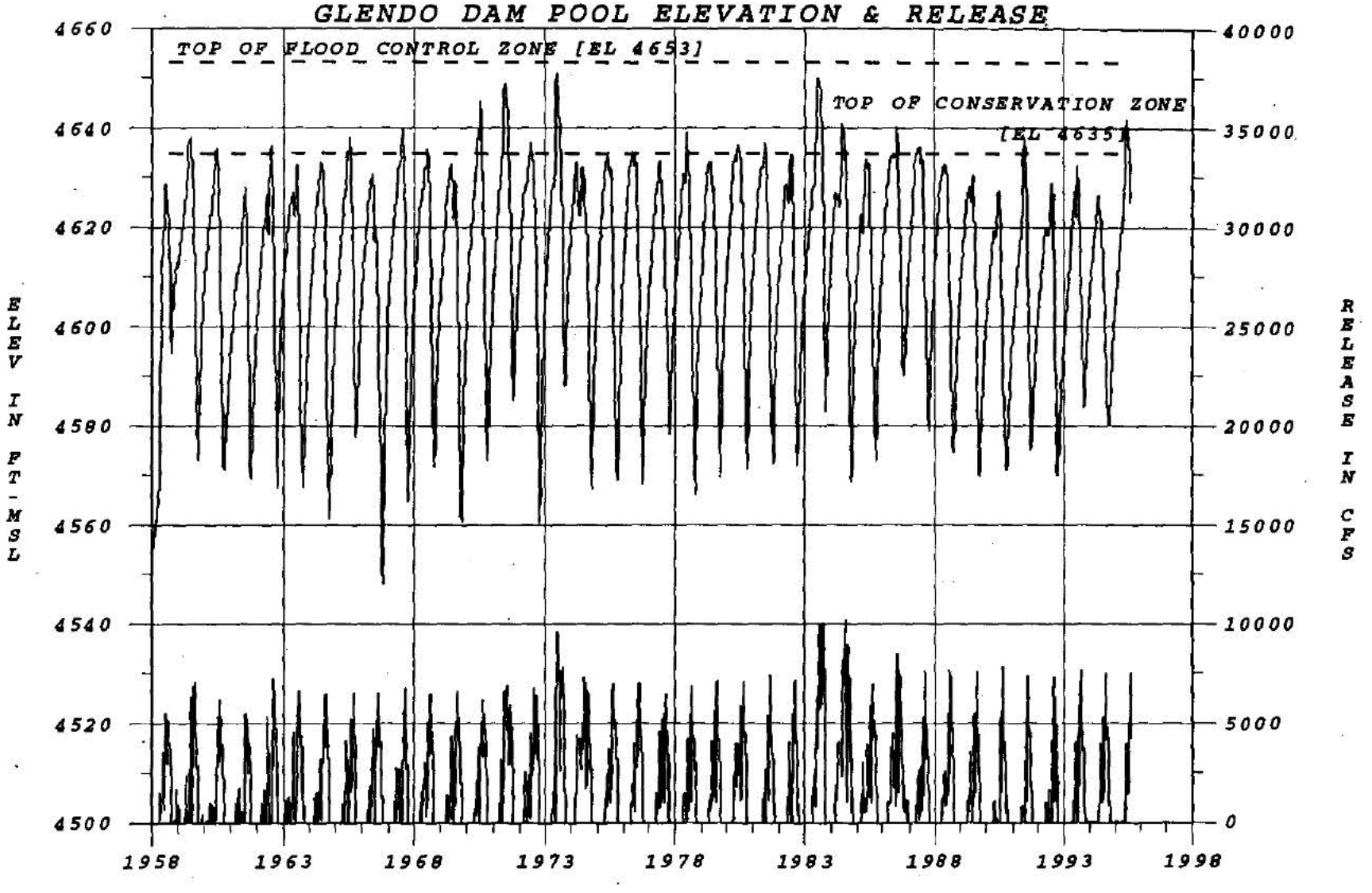
Peak Daily Inflow (CFS)
7925, Jun 10

Peak Daily Outflow (CFS)
7540, Jul 28

Peak Pool Elevation (Feet msl)
4641.67, Jun 14

Minimum Pool Elevation (Feet msl)
4580.01, Oct 03


GLENDO DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 4653]
TOP OF CONSERVATION ZONE [EL 4635]
ELEV IN FT-MSL
RELEASE IN CFS
4660
4650
4640
4630
4620
4610
4600
4590
4580
4570
4560
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

HEART BUTTE DAM AND RESERVOIR (LAKE TSCHIDA)
HEART RIVER BASIN, NORTH DAKOTA
1994-1995 REGULATION

Heart Butte Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone. When this occurs, release determination is the responsibility of the Corps (District Engineer) as per the Field Working Agreement dated March 15, 1951.

The pool entered the flood control zone late February and remained in the flood control zone for the rest of the report period. The peak inflow on May 13 of 2003 cfs was reduced to a discharge of 1145 cfs. Regulation was accomplished by the uncontrolled outlet works.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	22,450 cfs May 09 70	4,050 cfs Apr 09 52
2nd	22,000 cfs Apr 17 50	3,931 cfs May 31 78
3rd	12,960 cfs Apr 06 52	3,864 cfs May 13 70

	Pool-Date
Highest	2086.23 Apr 09 52
2nd	2083.77 Mar 31 78
3rd	2082.70 May 12 70

Minimums of Record (since initial fill):

	Pool-Date
Lowest	2049.04 Oct 31 91
2nd	2049.22 Oct 31 92
3rd	2051.44 Nov 07 90

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
81,055, 87% of normal

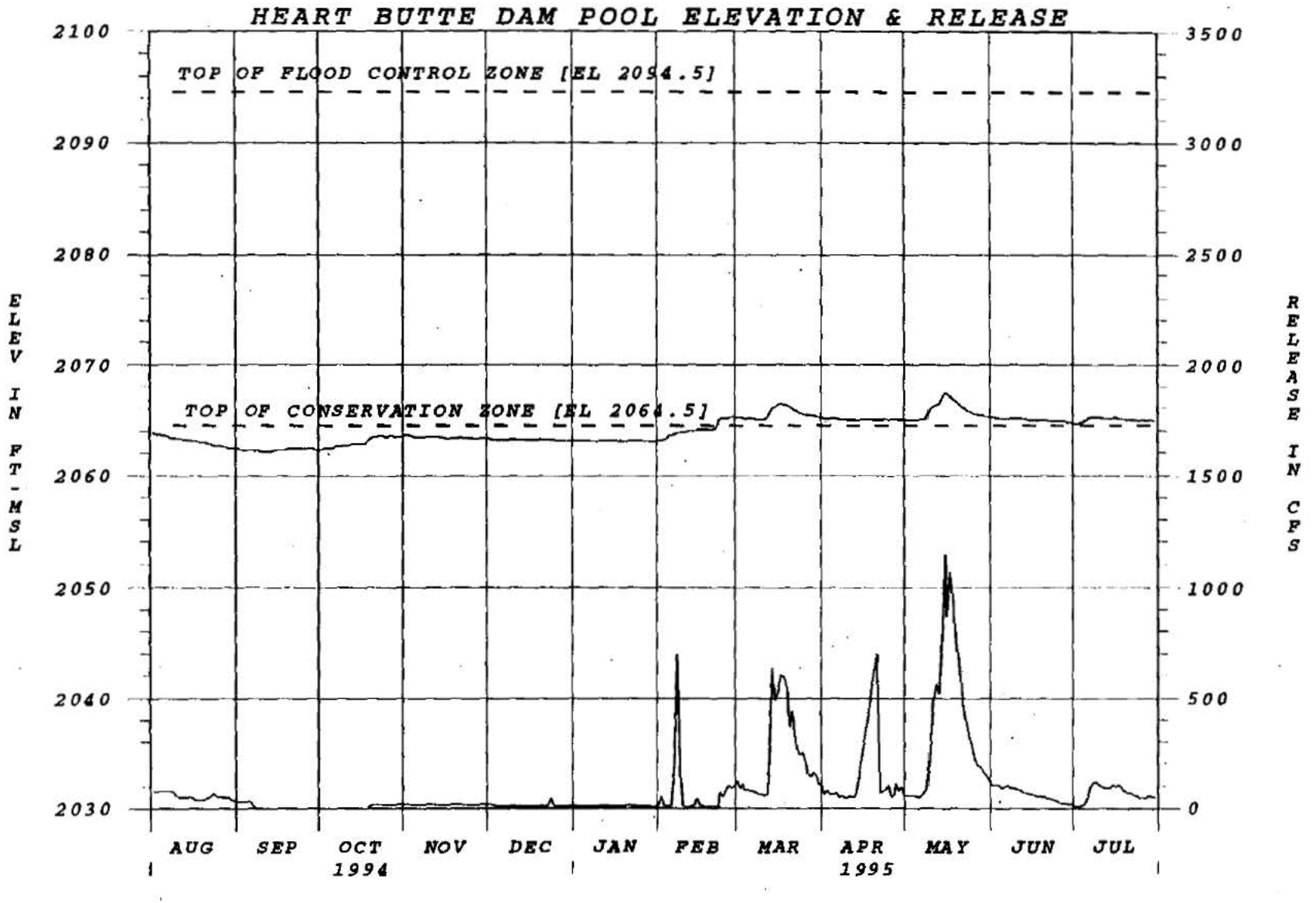
Total Outflow (AF)
66,535, 79% of normal

Peak Daily Inflow (CFS)
2003, May 13

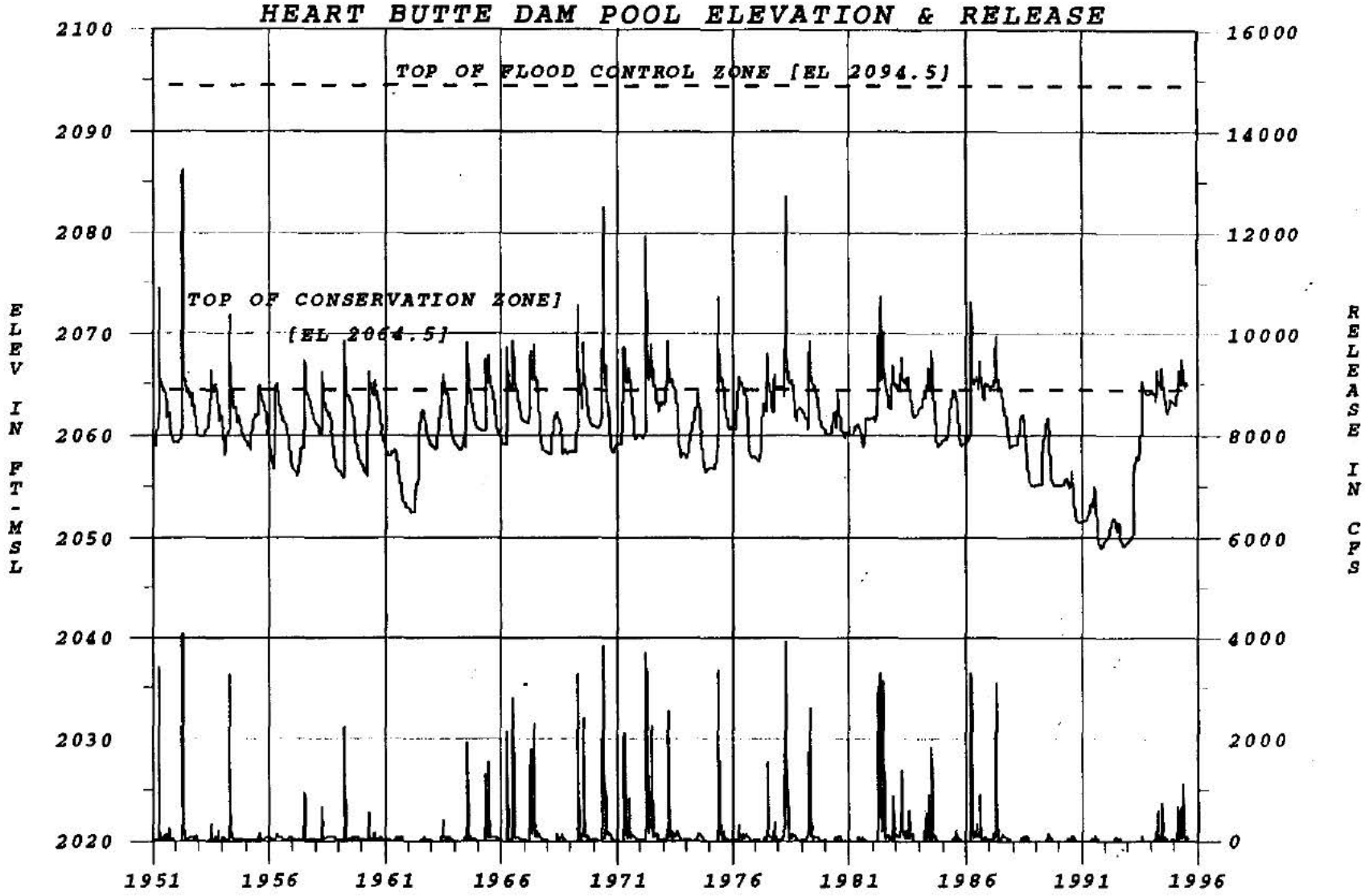
Peak Daily Outflow (CFS)
1145, May 14

Peak Pool Elevation (Feet msl)
2067.43, May 14

Minimum Pool Elevation (Feet msl)
2062.16, Sep 12



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

JAMESTOWN DAM AND RESERVOIR
JAMES RIVER BASIN, NORTH DAKOTA
1994-1995 REGULATION

Jamestown Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of joint use conservation-flood control zone required for flood control, as per the Field Working Agreement dated July 15, 1975. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer). For a description of the flooding that took place in 1995 see the text in the main body of the report.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	7,689 cfs Apr 17 69	878 cfs Apr 26 95
2nd	4,581, cfs Mar 30 94	718 cfs Aug 23 93
3rd	4,351 cfs Mar 24 95	712 cfs Apr 13-15 94

	Pool-Date	
Highest	1444.10 Apr 27 69	(USBR 1443.80 May 02 69)
2nd	1442.86 Apr 18 95	
3rd	1442.83 Aug 15 93	

Minimums of Record (since initial fill):

	Pool-Date
Lowest	1420.91 Feb 27 93
2nd	1421.85 Jul 31 92
3rd	1423.53 Jul 31 91
4th	1425.58 Jul 31 90

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
201,231, 556% of normal

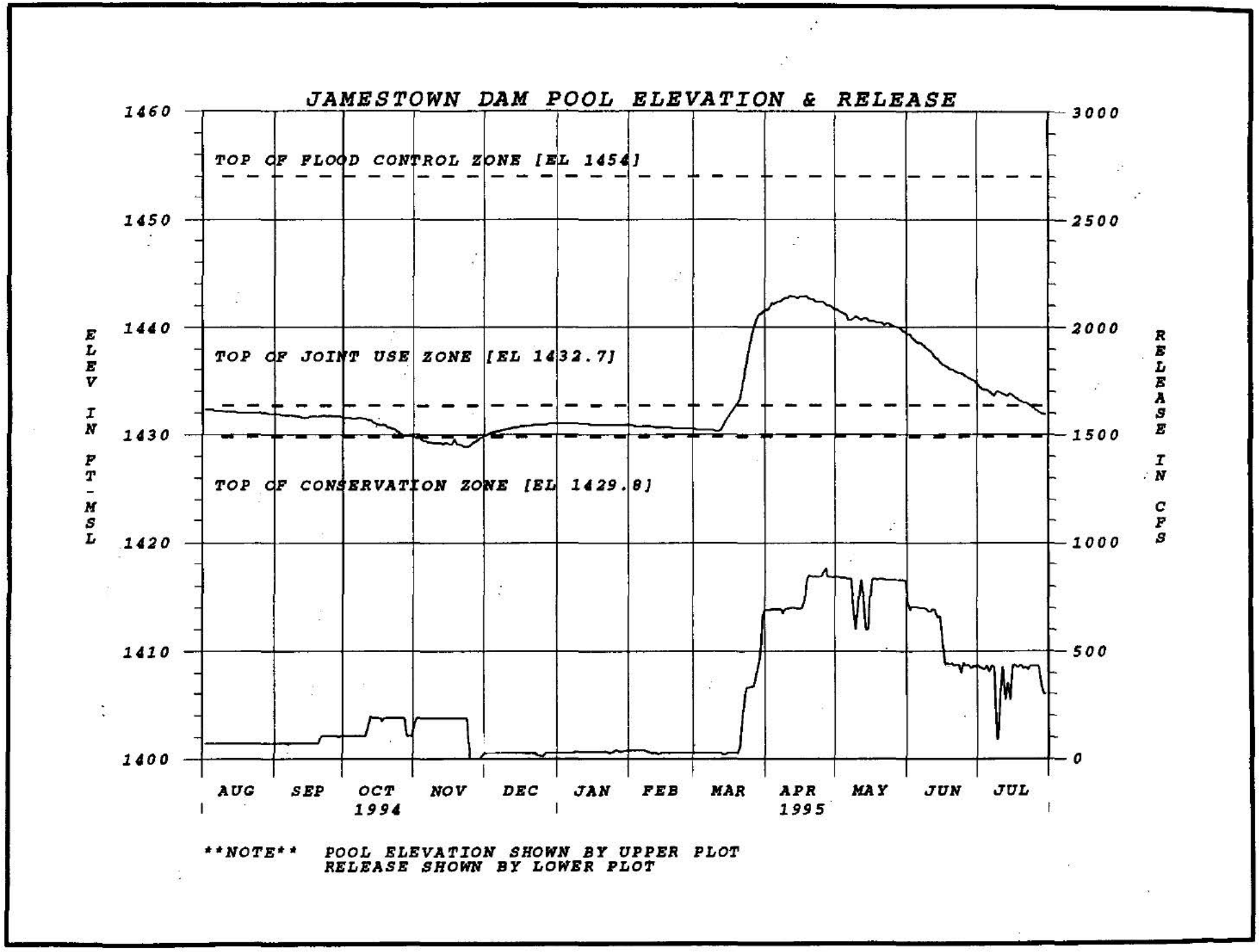
Total Outflow (AF)
192,863, 770% of normal

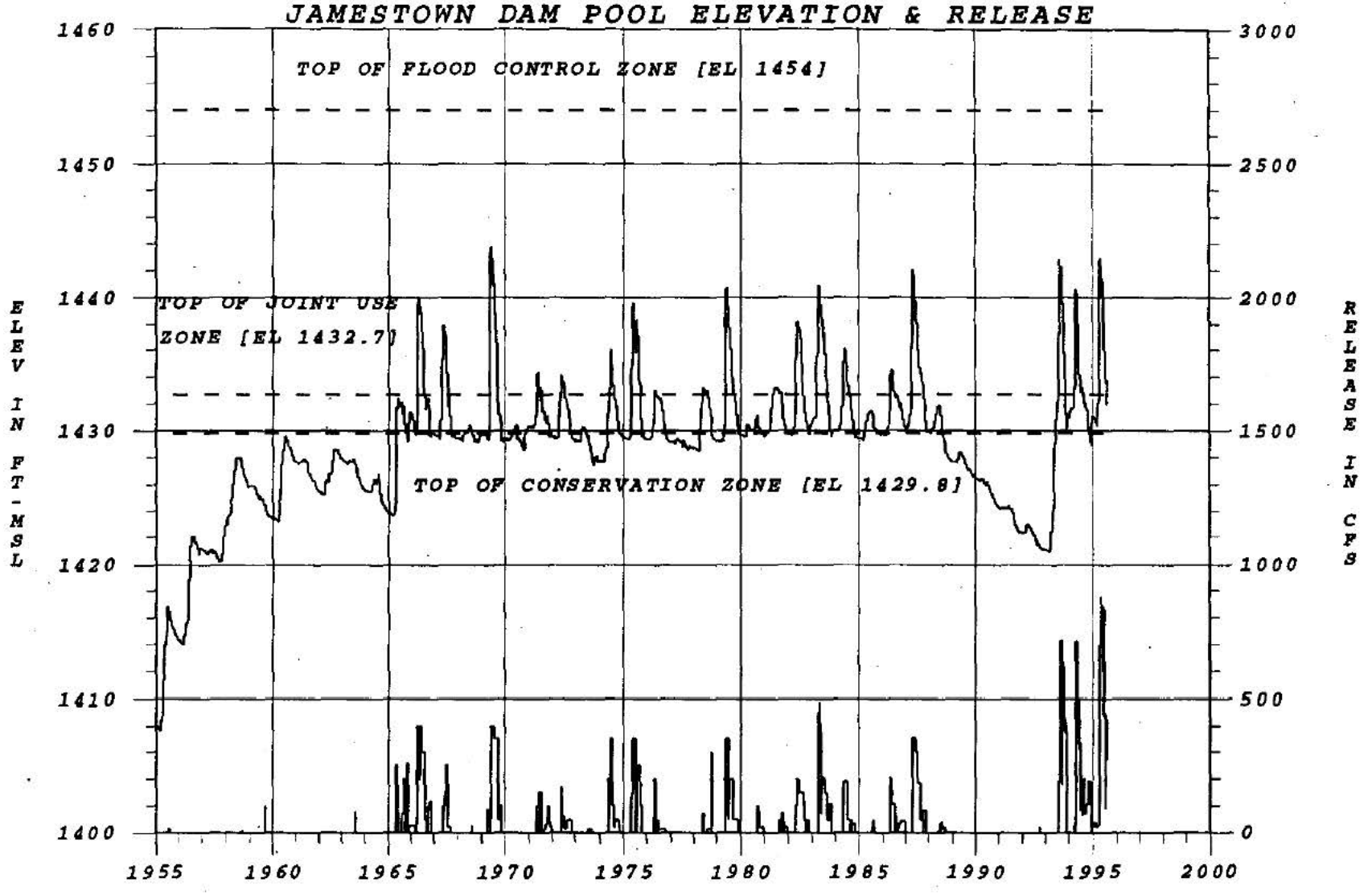
Peak Daily Inflow (CFS)
4351, Mar 24

Peak Daily Outflow (CFS)
878, Apr 26

Peak Pool Elevation (Feet msl)
1442.86, Apr 18

Minimum Pool Elevation (Feet msl)
1429.75, Nov 15


JAMESTOWN DAM POOL ELEVATION & RELEASE
TOP OF FLOOD CONTROL ZONE [EL 1454]
TOP OF JOINT USE ZONE [EL 1432.7]
TOP OF CONSERVATION ZONE [EL 1429.8]
ELEV IN FT-MSL
RELEASE IN CFS
1460
1450
1440
1430
1420
1410
1400
3000
2500
2000
1500
1000
500
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

KEYHOLE DAM AND RESERVOIR
BELLE FOURCHE RIVER BASIN, WYOMING
1994-1995 REGULATION

Keyhole Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated February 11, 1970. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

The pool did not reach the flood control zone during the report period.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	10,720 cfs May 19 78	1,347 cfs May 24 78
2nd	4,780 cfs Feb 29 72	820 cfs May 23-24 62
3rd	3,530 cfs Jun 18 62	801 cfs Mar 11-15 72

	Pool-Date
Highest	4100.38 May 07 78
2nd	4098.78 Mar 07 72
3rd	4096.41 May 06 73

Minimums of Record (since initial fill):

	Pool-Date
Lowest	4060.32 Nov 01 92
2nd	4063.86 Jul 22-23 92
3rd	4066.94 Dec 12-22 90
4th	4070.73 Sep 18 89

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
36,095, 110% of normal

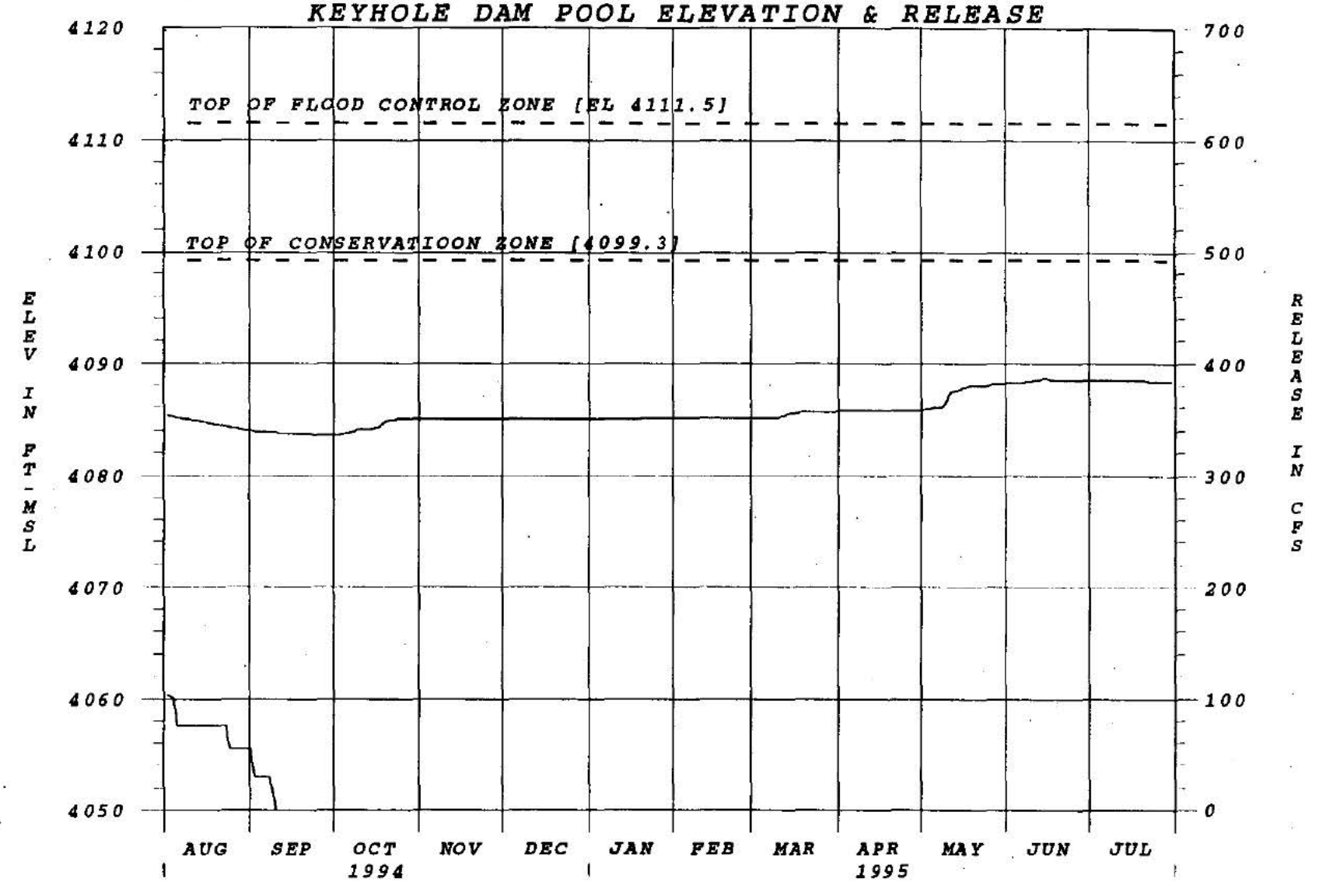
Total Outflow (AF)
4,950, 33% of normal

Peak Daily Inflow (CFS)
1552, May 10

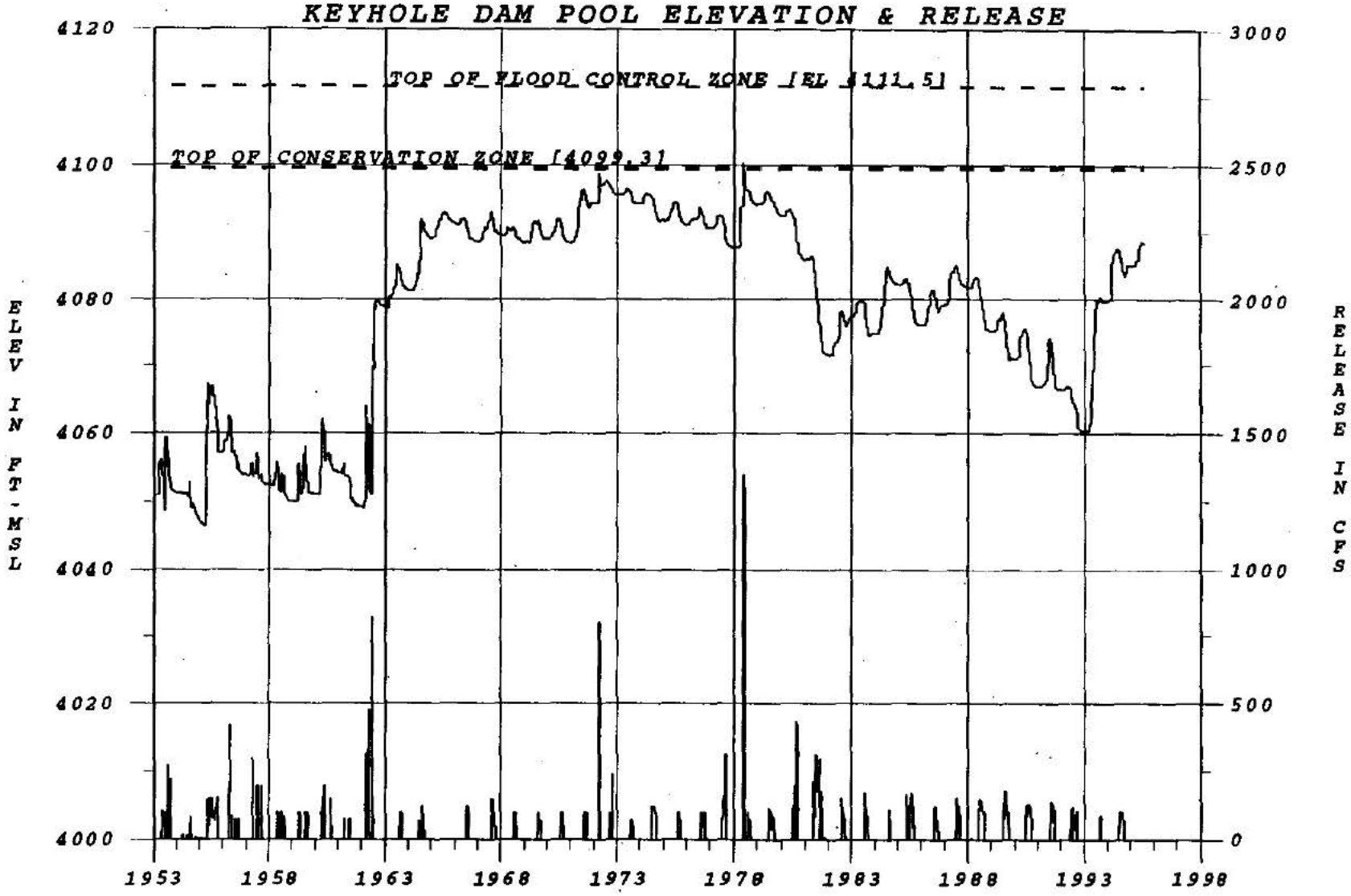
Peak Daily Outflow (CFS)
103, Aug 01

Peak Pool Elevation (Feet msl)
4088.77, Jun 15

Minimum Pool Elevation (Feet msl)
4083.57, Sep 29



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

PACTOLA DAM AND RESERVOIR
RAPID CREEK BASIN, SOUTH DAKOTA
1994-1995 REGULATION

The pool entered the flood control zone twice during the report period.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	1,110 cfs May 16 65	500 cfs May 20 65
2nd	718 cfs May 09 95	350 cfs May 22 78
3rd	541 cfs Jun 08 93	350 cfs May 16 95

	Pool-Date
Highest	4585.87 May 19 65
2nd	4585.44 May 21 78
3rd	4585.06 Jan 22 72

Minimums of Record (since initial fill):

	Pool-Date
Lowest	4531.53 Jan 24 91
2nd	4533.12 Feb 21 90

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
57,677, 171% of normal

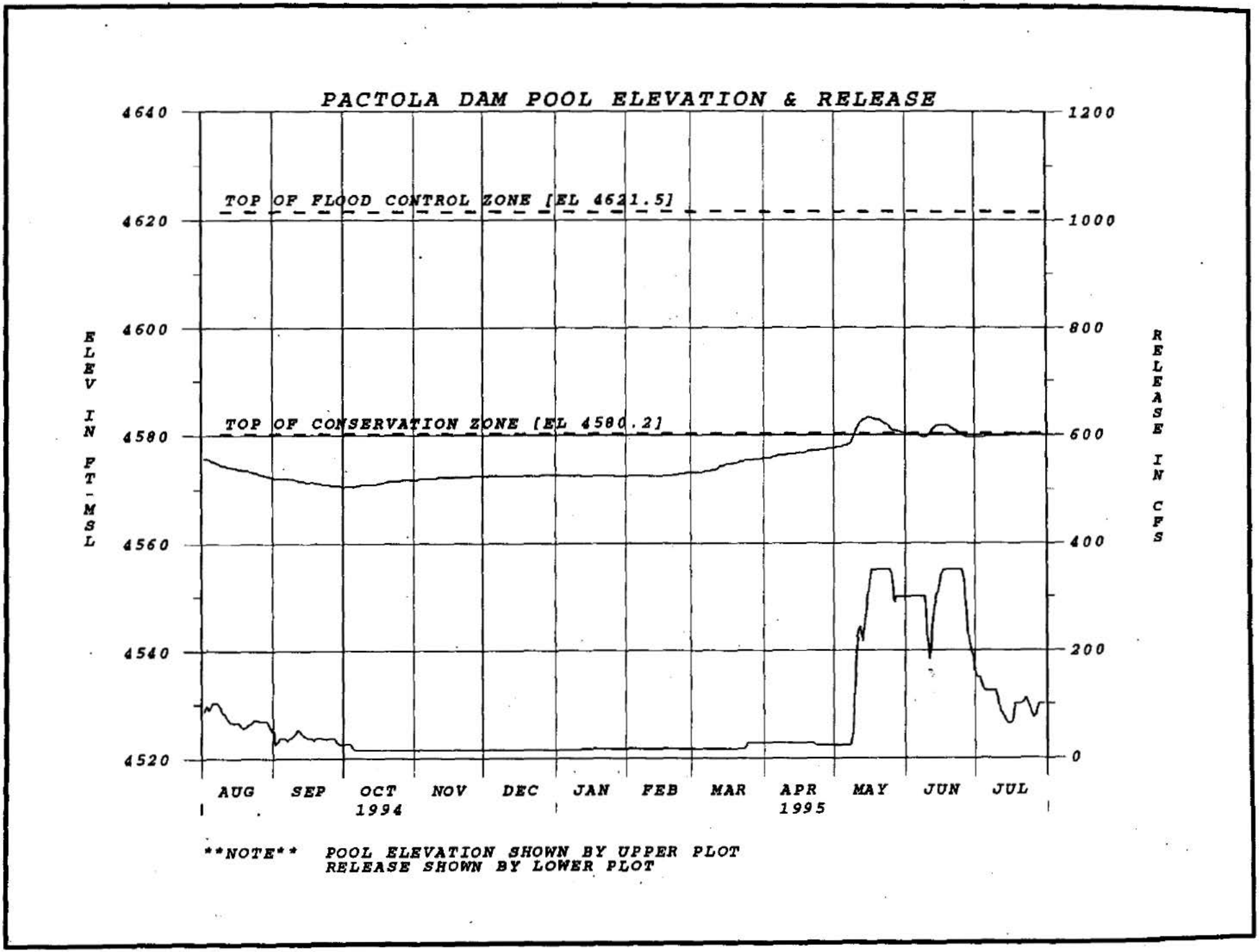
Total Outflow (AF)
52,626, 176% of normal

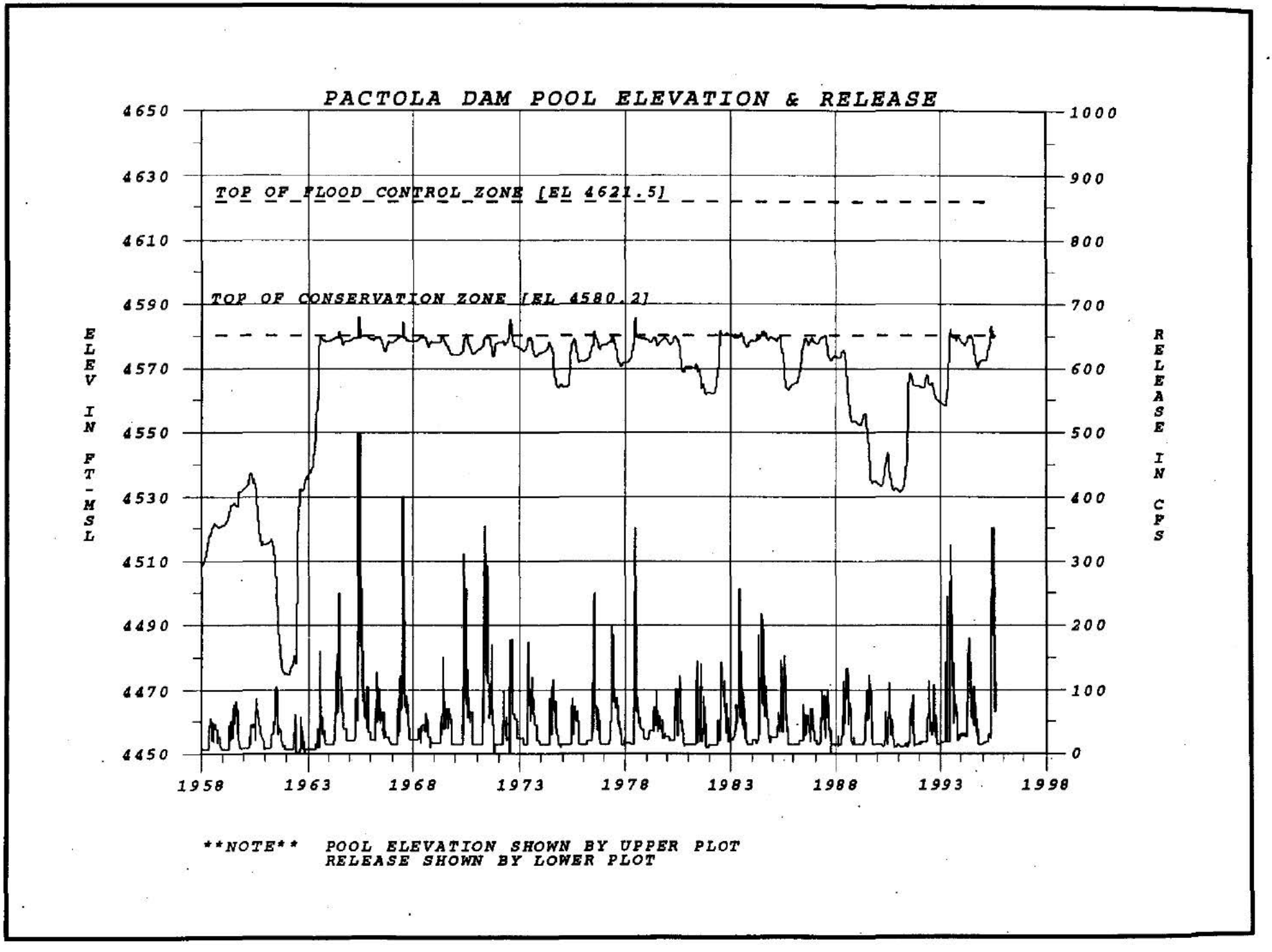
Peak Daily Inflow (CFS)
718, May 09

Peak Daily Outflow (CFS)
350, May 16

Peak Pool Elevation (Feet msl)
4583.31, May 15

Minimum Pool Elevation (Feet msl)
4570.44, Sep 30


PACTOLA DAM POOL ELEVATION & RELEASE
4640
4620
4600
4580
4560
4540
4520
1200
1000
800
600
400
200
0
TOP OF FLOOD CONTROL ZONE [EL 4621.5]
TOP OF CONSERVATION ZONE [EL 4580.2]
ELEV IN FT-MSL
RELEASE IN CFS
AUG
SEP
OCT
1994
NOV
DEC
JAN
FEB
MAR
APR
1995
MAY
JUN
JUL
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

SHADEHILL DAM AND RESERVOIR
GRAND RIVER BASIN, SOUTH DAKOTA
1994-1995 REGULATION

Shadehill Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated May 15, 1972. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

The pool remained in the flood control zone from mid-May until mid-July. The uncontrolled outlet works regulated the pool level during this period.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	32,152 cfs Apr 08 52	5,078 cfs Apr 10 52
2nd	9,900 cfs Mar 29 78	4,190 cfs Apr 01 78
3rd	6,730 cfs Mar 13 72	3,020 cfs Mar 16 72

	Pool-Date
Highest	2297.90 Apr 10 52
2nd	2282.42 Apr 01 78

Minimums of Record (since initial fill):

	Pool-Date
Lowest	2258.62 Nov 17 81
2nd	2259.11 Feb 28 62

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
166,663, 218% of normal

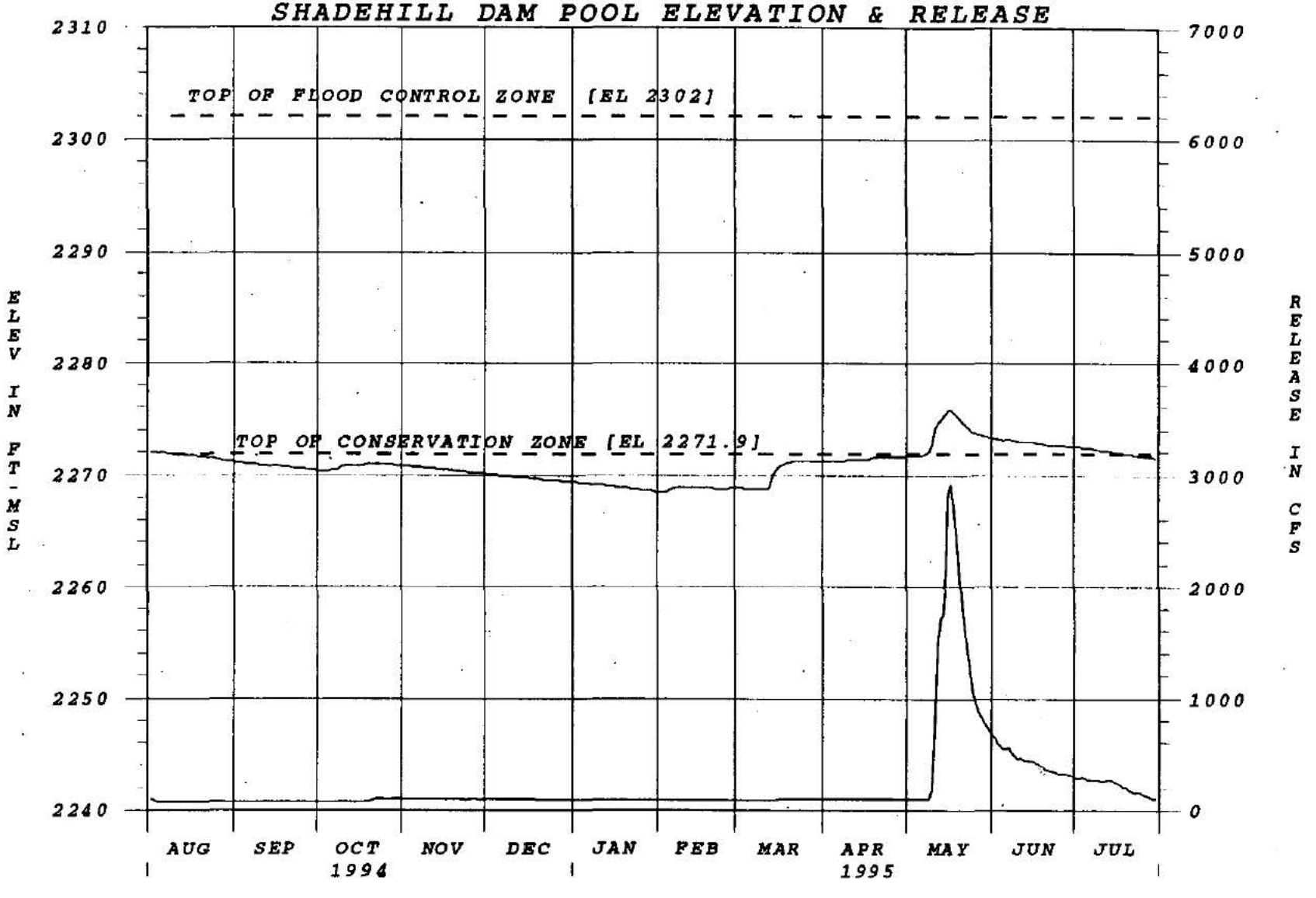
Total Outflow (AF)
157,288, 251% of normal

Peak Daily Inflow (CFS)
4542, May 10

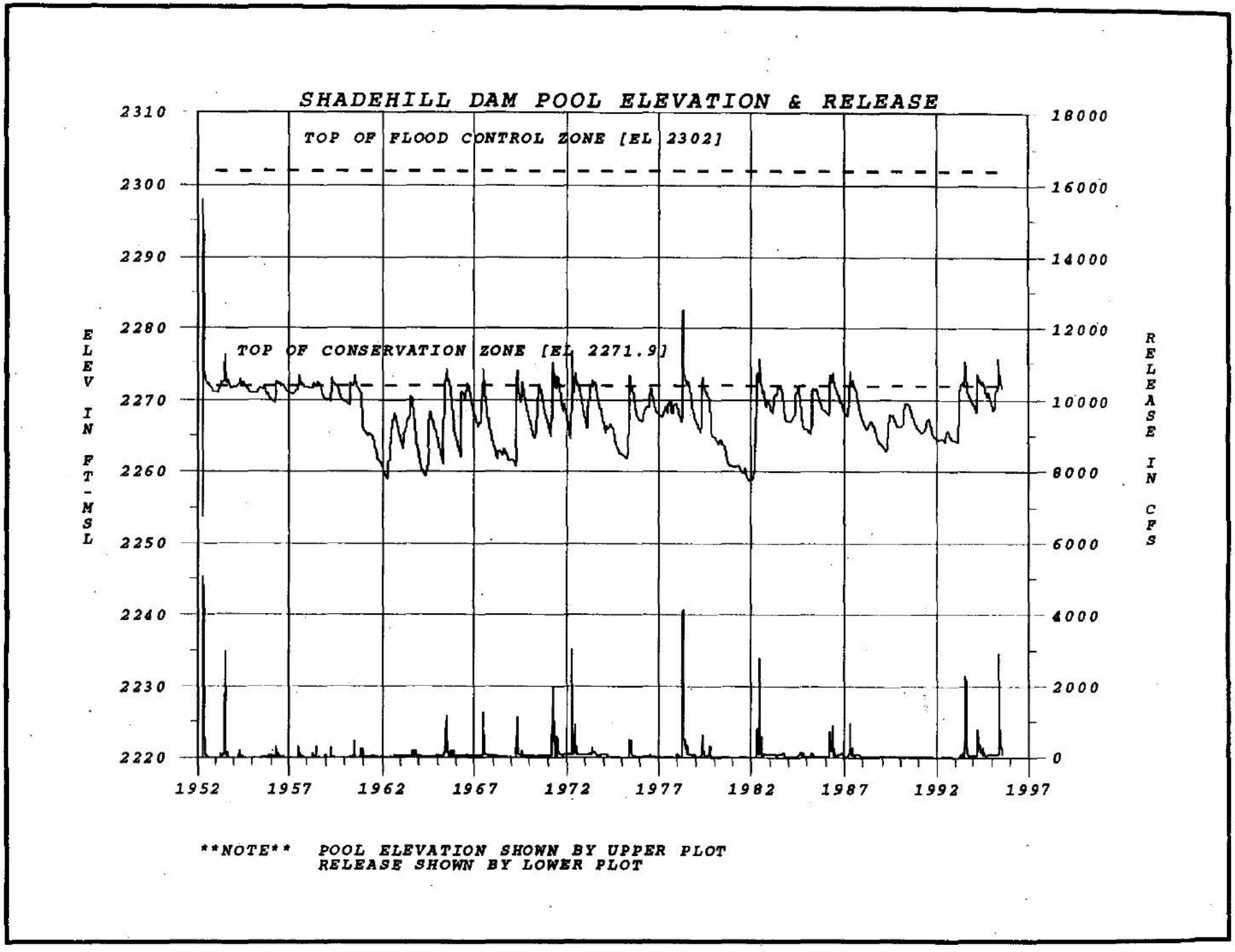
Peak Daily Outflow (CFS)
2911, May 16

Peak Pool Elevation (Feet msl)
2275.83, May 15

Minimum Pool Elevation (Feet msl)
2268.51, Feb 01-02



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

TIBER DAM AND RESERVOIR (LAKE ELWELL)
MARIAS RIVER BASIN, MONTANA
1994-1995 REGULATION

Tiber Reservoir is regulated by the Bureau of Reclamation except when the pool level rises into the flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control as per the Water Control Agreement. When this occurs, release determination is the responsibility of the Corps (District Engineer). when replacement storage is required for the downstream Fort Peck Reservoir, releases from Tiber Dam will be adjusted beginning March 1, based on anticipated inflow, to fill the reservoir to elevation 3008.1 feet msl prior to mid-July. Minimum releases to achieve this fill are 300 cfs.

Water was stored in the flood control zone from June 10th to July 12th. The peak inflow of 15,500 cfs was reduced to a release of 2,000 cfs.
Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	102,888 cfs Jun 10 64	10,300 cfs Jun 13-14 64
2nd	53,053 cfs Jun 21 75	5,777 cfs Jun 25 75 Jul 11 75
3rd	25,200 cfs Feb 26 86	5,308 cfs Jun 22-24 67

	Pool-Date
Highest	3005.59 Jul 12 65
2nd	3001.91 Jun 13 64
3rd	2995.53 Jul 03 91

Minimums of Record (since initial fill):

	Pool-Date
Lowest	2953.81 Mar 28 68
2nd	2955.31 Apr 27 67

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
755,162, 113% of normal

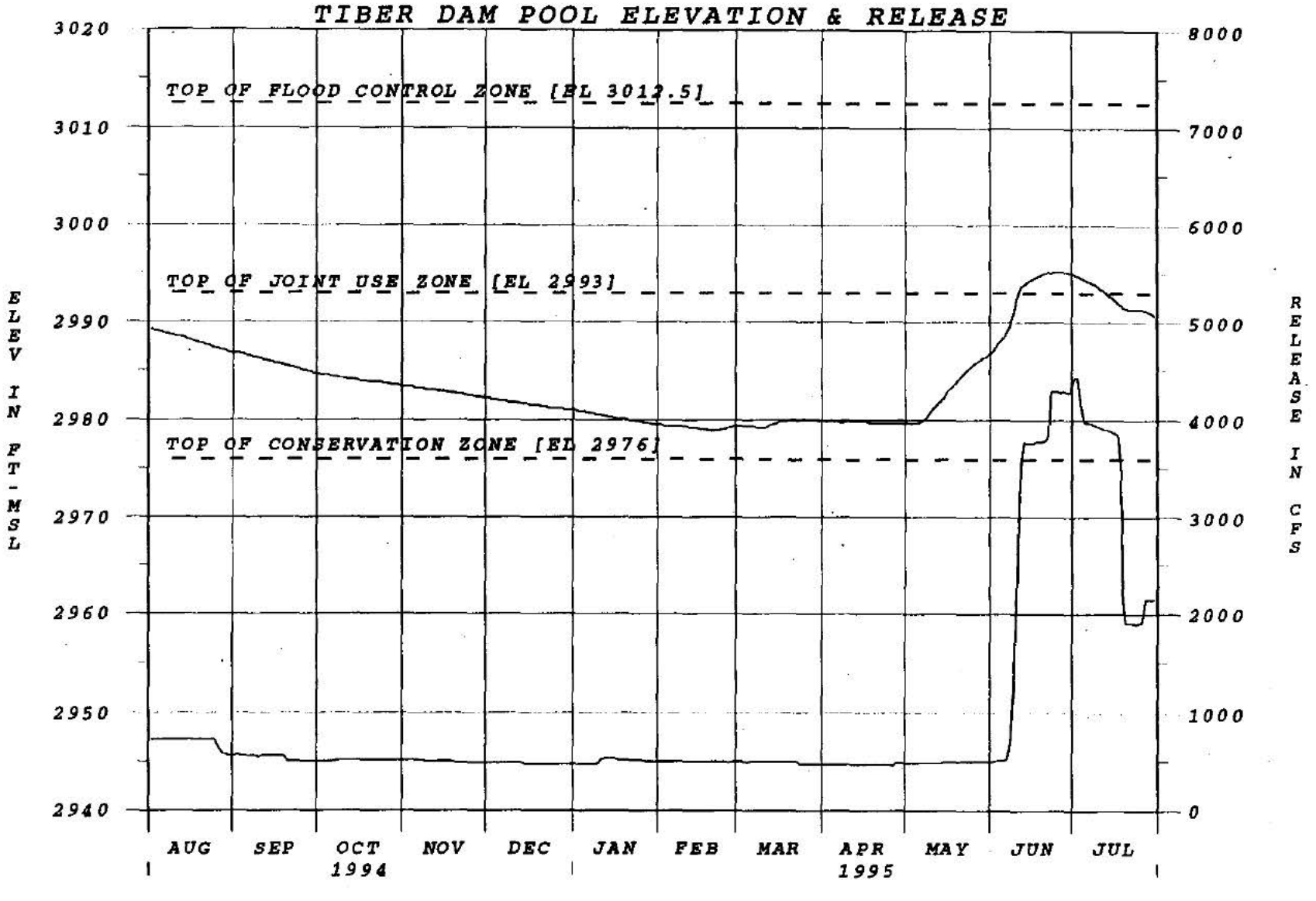
Total Outflow (AF)
685,920, 113% of normal

Peak Daily Inflow (CFS)
15,495, Jun 09

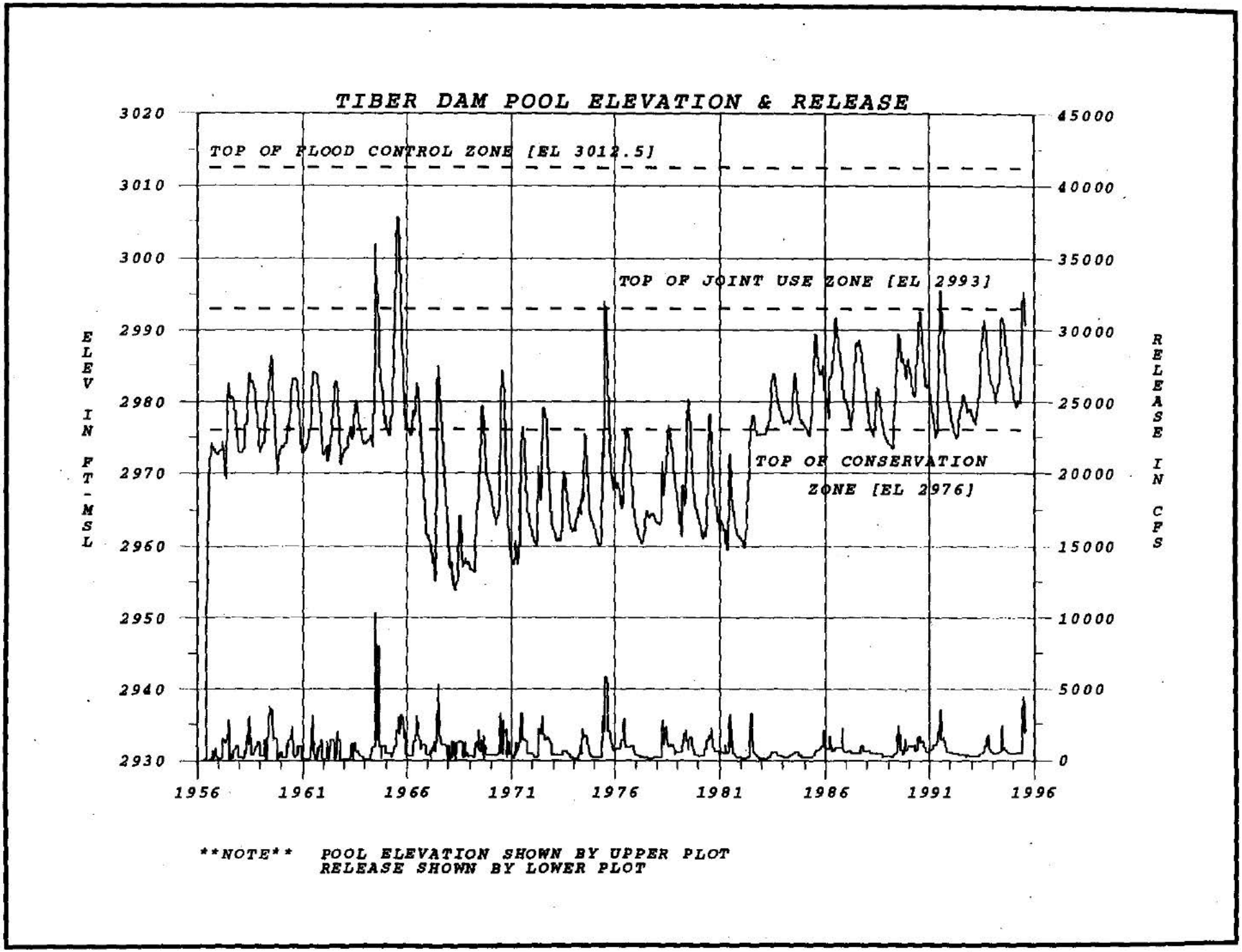
Peak Daily Outflow (CFS)
4431, Jul 01

Peak Pool Elevation (Feet msl)
2995.29, Jun 25

Minimum Pool Elevation (Feet msl)
2978.97, Feb 20



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT

YELLOWTAIL DAM/BIGHORN RESERVOIR
BIG HORN RIVER BASIN, MONTANA
1994-1995 REGULATION

Yellowtail Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone (3640 ft. above MSL) or that portion of the joint use zone required for flood control as per Field Working Agreement Dated March 5, 1971. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

Refer to Chapter VI for the writeup of the flood control regulation of Yellowtail Dam/Bighorn Reservoir.

Maximums of Records:

	Daily Inflow-Date	**Daily Outflow-Date**
Highest	29,775 cfs Jul 01 67	24,721 cfs Jul 08 67
2nd	19,005 cfs Jun 10 81	14,947 cfs Jul 03 70
3rd	18,607 cfs Jun 26 69	14,415 cfs Jul 19 95

	Pool-Date
Highest	3656.36 Jul 06 67
2nd	3648.55 Jul 13 78
3rd	3647.11 Jun 26 91

Minimums of Record (since initial fill):

	Pool-Date
Lowest	3583.30 Apr 14 89
2nd	3584.45 Mar 11 70

Report Period: (August 1, 1994 through July 31, 1995)

Total Inflow (AF)
2,492,481, 101% of normal

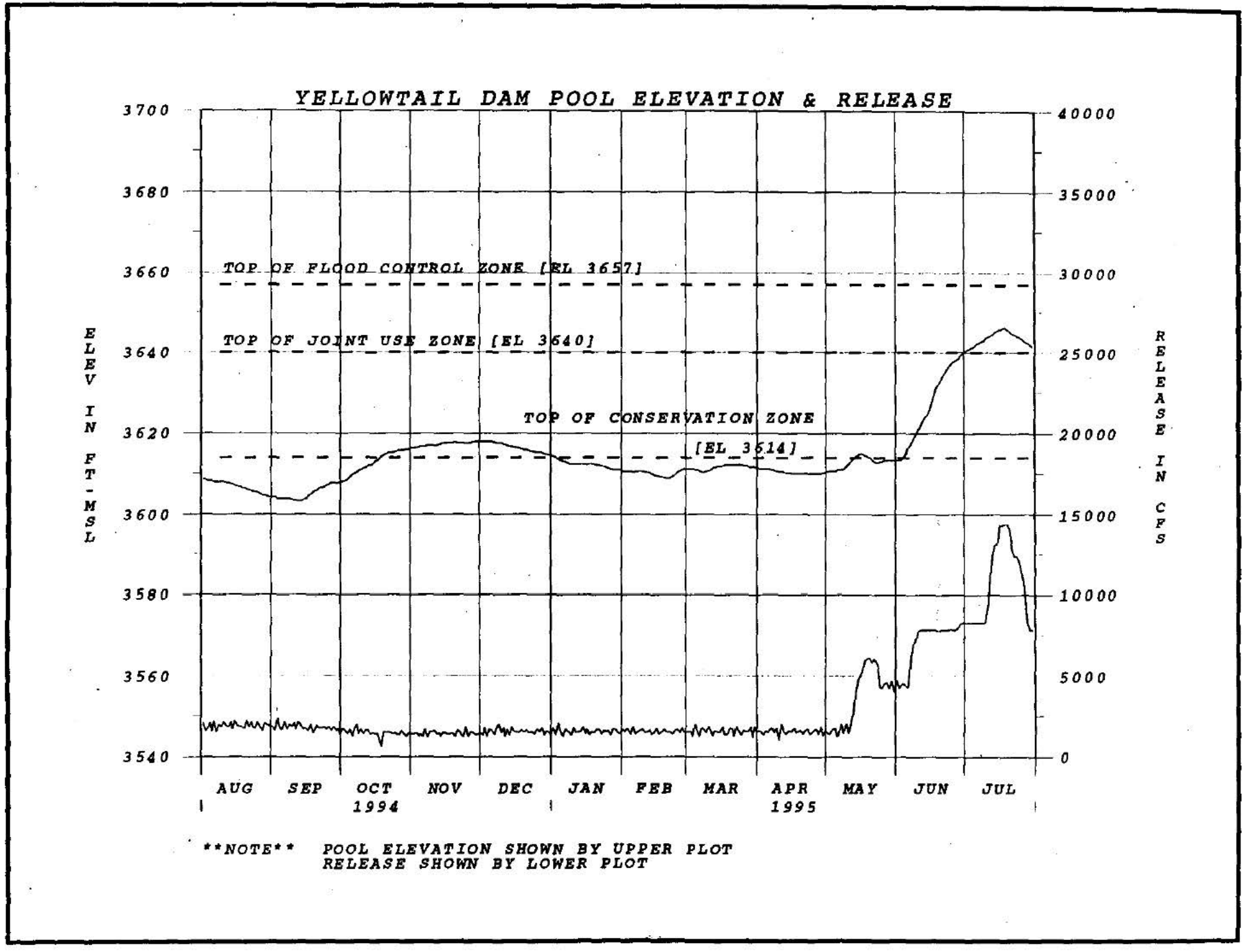
Total Outflow (AF)
2,200,382, 91% of normal

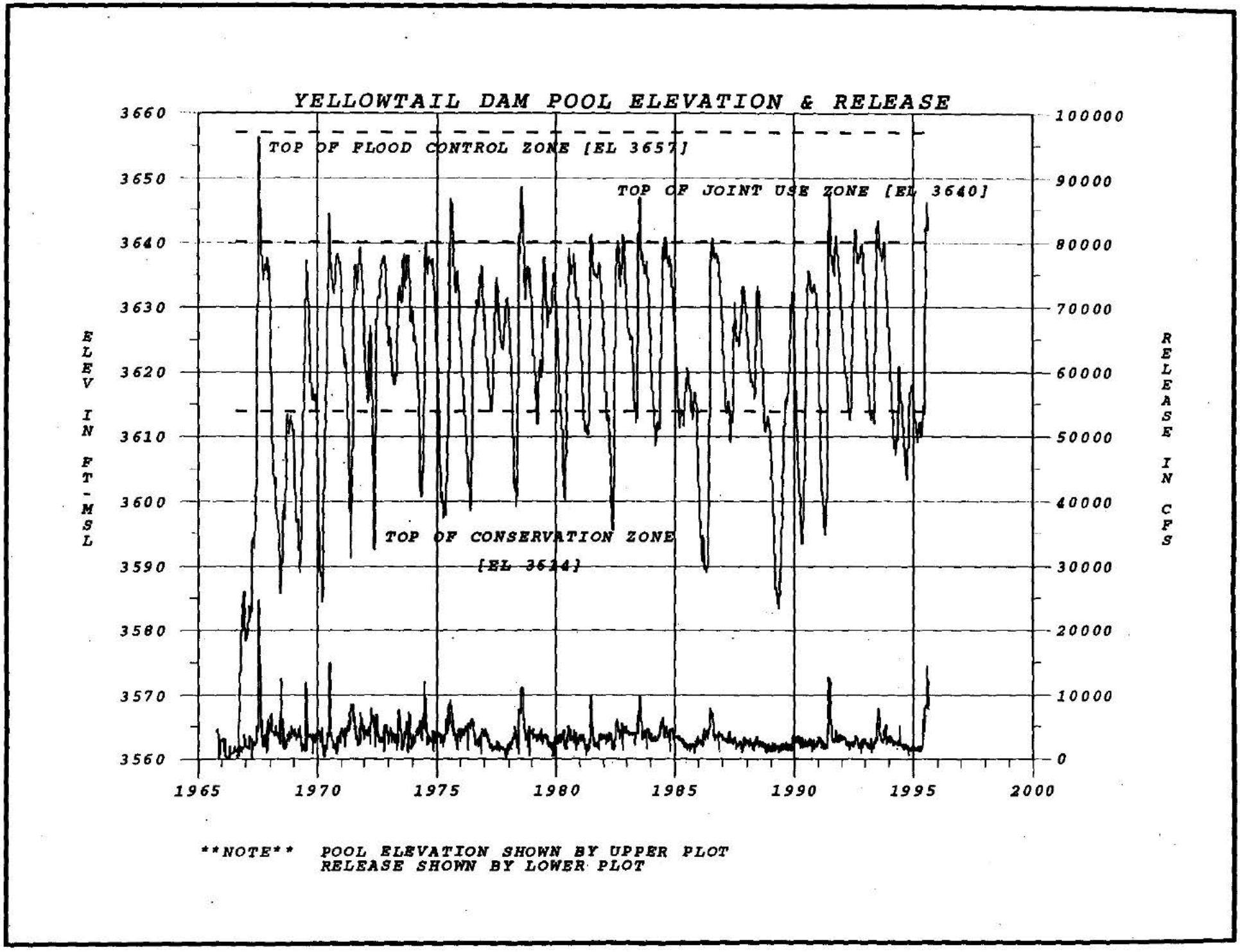
Peak Daily Inflow (CFS)
18,180, Jul 15

Peak Daily Outflow (CFS)
14,415, Jul 19

Peak Pool Elevation (Feet msl)
3646.30, Jul 17

Minimum Pool Elevation (Feet msl)
3603.35, Sep 13


YELLOWTAIL DAM POOL ELEVATION & RELEASE
3700
3680
3660
3640
3620
3600
3580
3560
3540
ELEV IN FT-MSL
40000
35000
30000
25000
20000
15000
10000
5000
0
RELEASE IN CFS
TOP OF FLOOD CONTROL ZONE [EL 3657]
TOP OF JOINT USE ZONE [EL 3640]
TOP OF CONSERVATION ZONE
[EL 3614]
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994
1995
NOTE POOL ELEVATION SHOWN BY UPPER PLOT
RELEASE SHOWN BY LOWER PLOT



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RELEASE SHOWN BY LOWER PLOT